POWER

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ELY C. HUTCHINSON, *Editor*

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Fictitious Price Bait

Being in the market for the equipment of an extraordinarily important power house, a reputable public utility engaged a professional purchasing agent of wide local reputation to do the buying.

Competition was desperately keen, so here was the opportunity, thought the machinery men, to cash in on their assiduously developed friendship with the purchasing Pooh-Bah.

The buyer's representative, sensing the situation, was also anxious to prove to his employer the wisdom of selecting him for such an important work.

So, choosing two competitors for each principal division of the job, the agent told each confidentially of the purity of his desire to befriend him. But, since his price was high, the best that could be done was to offer half the units at the other fellow's lower figure, which he then pretended to name. Thus each of the selected bidders was used in an attempt to force a competitor to accept a fictitious price for his product.

When the scheme was discovered the purchasing agent blandly called off the deal and announced he was ready to receive "final" prices from all.

And that purchasing agent occupies an important place in the business of his community today.

EDITORIALS

Power Services Rationalized

From long experience and discussion, the correct set-up of power services, and their relation to the power chief is gaining wide recognition. It is agreed that each service should carry a cost based on actual analysis of its components. It is also agreed that all important uses of power services, whether in the power plant itself or out in the factory, should be entered and charged.

The old idea of tacking power cost onto the product as part of the general overhead is all wrong, both theoretically and practically. It destroys all incentive toward reduced consumption. Moreover, where the factory output includes more than one product, application of power cost as an overhead charge makes it impossible to determine the true total cost of any product.

Accountants have again and again pointed to the pitfalls of erroneous cost-accounting. If true costs are not kept, some items are necessarily priced unduly low. Others are priced too high. The result often is volume sale of the very items that bring in little profit or perhaps even create a loss.

Any competent power engineer will naturally set up an adequate cost system within the power plant. He will also realize, better than anybody else, the all-around advantage of metered services. And he should be enough of a salesman to demonstrate their value—a step at a time, if need be.

Flywheels for Motor Applications

Attempts to use flywheels promiscuously on motors for peak-load troubles have led to disappointing results. A flywheel may appear to be a simple piece of equipment, but it must be applied intelligently or the trouble it is intended to correct may be made worse. The functions of a flywheel are to smooth out varying load torques and to absorb parts of peak loads. The two requirements are radically different. In the first the machine may run at a constant number of revolutions per unit of time, but the angular velocity varies during each revolution. Then for a flywheel to give out energy sufficient to supply part of the power required to meet a sudden peak load the motor speed must actually slow down.

A synchronous motor is inherently a constant-speed machine, but its angular velocity may change as the result of the varying torque required by reciprocating compressors. In synchronous-motor applications a flywheel is useful only in smoothing out torque irregularities. If a synchronous motor is driving a load that develops high peaks of short duration a flywheel may intensify the peak and cause other bad effects. Where the load cycle is such that a flywheel is required to smooth out the power peaks then a motor with a drooping speed characteristic must be used.

It is just as important to provide proper flywheel characteristics as to select the correct motor for the load. It might be thought that any flywheel is better than none. With synchronous-motor compressors this is not true, for it is possible to have a flywheel of such weight that it increases the pulsations of the power current. In some cases the operation of synchronous-motor-driven compressors has been improved by removing the flywheel. This does not mean that operation could not be improved by a proper flywheel. It does show, however, the necessity of correct analysis in flywheel applications.

Flywheels for motor-driven loads should not be chosen by cut and try methods. The characteristics of motors are well understood and the effect of a flywheel can be calculated accurately. If application engineers have any doubt as to the proper solution, the motor or machine manufacturers should be consulted. It generally costs less to be sure than to take a chance.

Steam Drip System

Provision for draining steam lines is a detail of power plant design frequently considered of minor importance and so left to the pipe fitter to install in whatever way his judgment may dictate. Generally the points to be drained are indicated on drawings, but the drain lines are seldom detailed.

It is not surprising, then, that drainage systems often constitute a constant source of annoyance to operating engineers. These conditions exist even though engineers are well aware of the importance of satisfactory drip systems to reliable plant operation.

Perhaps one of the reasons for the tendency to neglect the engineering of drip systems, as pointed out in an article in this number, is the lack of information concerning the quantities of condensate that they may be required to handle. This suggests the need of research to obtain data from which a method of calculating drip quantities can be developed. Such an investigation would yield information of value to the plant designer and might also be of assistance to the manufacturer.

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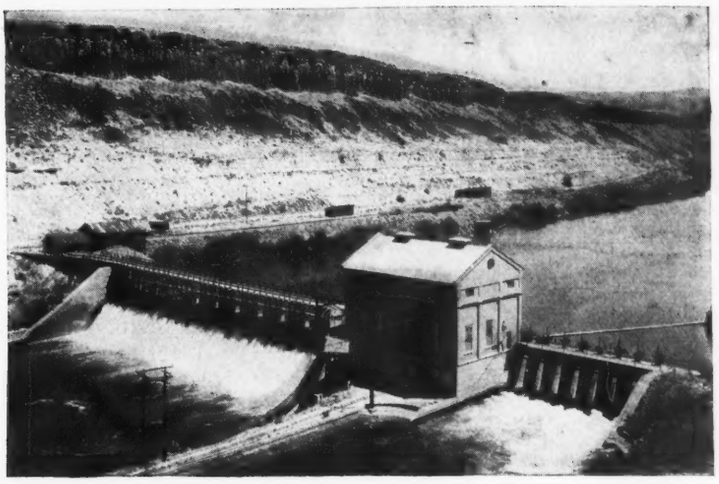
POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason



Boise River plant in Idaho has three units totaling 1,875 kilovolt-amperes

By Dr. HUGH A. BROWN

Director of Reclamation Economics
U. S. Bureau of Reclamation

Hydro Power Provides Revenue for Irrigation Works

By combining power development with irrigation dams it is possible to pay a project's construction cists from power sales. Under a new policy, power profits are first applied to repaying the power plant's cost, then the dam and reservoir cost, and after that they are credited to the reclamation fund

THIRTY years ago, when the Federal Reclamation Act was under consideration, power as a source of revenue for the construction of Federal irrigation works received no consideration by the framers of the act or by the administrative officials of the Department of the Interior and the then embryonic Bureau of Reclamation. The sole source of revenue provided in the act of June 17, 1902, to carry on construction, comprised yearly receipts from the sale of public land, which at that time amounted to about $4,600,000. This increased steadily to an average of $7,000,000 annually during the next seven years, reaching the maximum of $9,430,600 in 1908. Beginning in 1910, the yearly decline in this source of revenue has been steady. For the fiscal year ending June 30, 1931, receipts from the sale of public land amounted to only $635,000. Altogether, accretions to the reclamation fund from this source have amounted to nearly $111,000,000.

The steady decline in revenues from the original source of supply led to the enactment, on Feb. 25, 1920, of the oil leasing act. This legislation provided that for past production 70 per cent and for future production 52½ per cent of the amounts derived from bonuses, royalties and rentals in the mining of coal, phosphate, oil, oil shale, gas and sodium on the public domain should be paid into the reclamation fund. In 1921 the accretions to the fund from this source amounted to $4,617,700, and for the period 1921 to 1926 averaged about $4,680,000, reaching the maximum of $6,694,000 in 1924. Since then there has also been a marked decline in the receipts from this source, with a low level of $1,853,000 in 1929. The total receipts from this source to June 30, 1931, have been $40,385,000.

Potassium royalties and rentals have added $80,000 to the fund and Federal water-power licenses an additional $212,000.

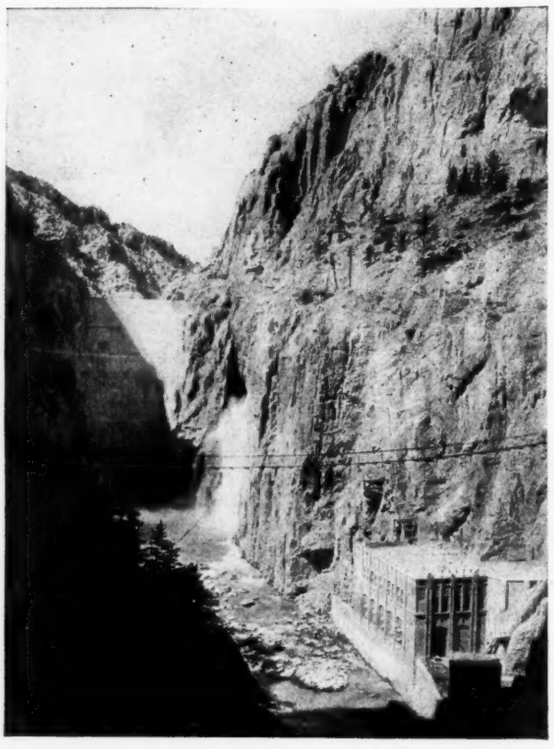
While the curve of accretions to the fund from these sources was following first an upward and then a decided downward trend, another source of revenue was being developed. This comprised repayments of construction charges by the water users who were benefited by the construction of the Federal irrigation works and formed the basis of the revolving feature of the fund. Under this arrangement, money coming into the fund would be expended on construction and be repaid to the government by the water users in the form of annual construction charges.

In 1908, when water was first being delivered by the bureau to the earliest projects, construction repayments by the water users amounted to only $154,200. In 1918 the receipts had passed the million mark and in 1925 were above $4,200,000. Since then they have fluctuated between $2,132,000 in 1927 and $4,338,000 in 1931. The total amount of construction repayments was $43,243,000 on June 30, 1931.

The Bureau of Reclamation has experienced two periods in its life when it was necessary to call on the United States Treasury for additional funds to maintain the pace of construction at an efficient rate. Under the act of June 25, 1910, the fund was augmented by a loan of $20,000,000. It was provided in a subsequent amendment that reimbursement to the Treasury should be made at the rate of $1,000,000 a year, beginning in 1920, $11,000,000 having been repaid from the reclamation construction fund up to 1930.

During the winter of 1930-31 it became evident that the construction income was not going to be sufficient to

keep pace with the construction program. This was due to two main causes. That winter was one of the most open winters in the meteorological history of the nation. The snowfall was almost universally light and temperatures were relatively mild. As a consequence contractors on several large reclamation construction jobs were able to push their work at an unprecedented rate and thus to increase their contract earnings by



Shoshone plant in Wyoming has two 8,000-kva. units

encumbering the reclamation fund far beyond what had been anticipated. The low prices of agricultural products affected the water users on the projects precisely as farmers throughout the nation were affected. As a result there was a marked falling off in the repayment of construction charges, thus further depleting the anticipated construction revenue.

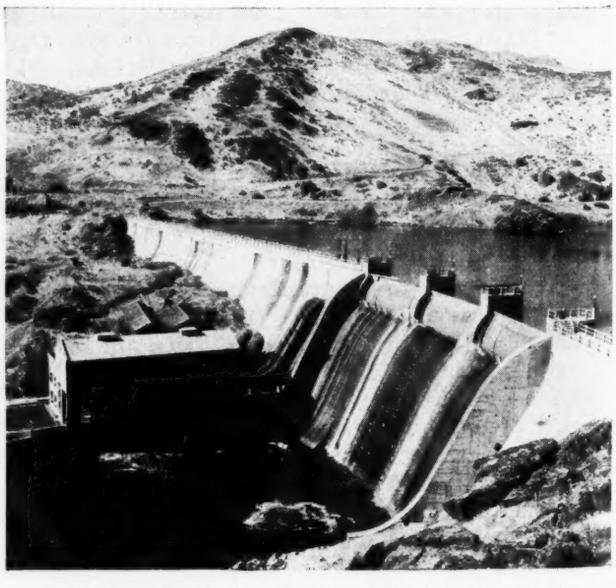
To meet the acute emergency and keep the construction program moving at the most efficient rate, and to avoid the necessity of practically closing down the work and discharging 1,500 or more workmen, the bureau requested a moratorium on the repayment of the $20,000,000 bond loan and a further loan of $5,000,000 from the Treasury. These requests were granted by Congress, but they will afford only temporary relief. Congress stipulated that repayments on the bond loan should begin again in 1932 and that repayment of the $5,000,000 loan should begin in 1933, each at the rate of $1,000,000 a year. As a result, beginning in 1933 the bureau will have to deduct from its construction income $2,000,000 a year for the next five years, and construction will necessarily be restricted, despite the crying need particularly for the rehabilitation of developed projects which have got into financial difficulties and are urging the government to come to their aid. It is estimated that these deductions from the fund will reduce the annual construction income to about $4,500,000, whereas the bureau will need approximately $8,000,000 annually to keep pace with the ten-year program adopted four years ago and approved, at least informally, by Congress.

In this situation, the bureau is looking ahead to some other source of revenue that, notwithstanding the declining receipts from the sale of public lands and from oil royalties and the virtually stationary income to be expected annually for some years to come through repayments by the water users, will make it possible to continue at a reasonable rate the beneficent work of Federal reclamation. The answer appears to be to create a revenue from power by building power plants as adjuncts to irrigation works. There are opportunities for this at nearly every storage reservoir. The total gross power sales from works already built are about three and a half million dollars yearly.

It has been pointed out that practically every American community with a population of 1,000 or more enjoys electric service and about half the villages with a population between 250 and 1,000. Less than 25 years ago there were only 2,000,000 customers of the electric industry. Today there are 20,000,000 domestic consumers alone, and electrically served homes house 70 per cent of the people. Electric labor-saving devices number more than 200, each performing a different service. More than 600,000 farms have been electrified in the past ten years. These and similar statements about the tremendous growth and the potential importance of power development and distribution stagger the imagination. They also point the way to a possible method of recouping, to some extent at least, the declining income available for the construction of additional feasible and sorely needed irrigation projects and the rehabilitation of already developed areas.

At first the financial possibilities of power development on the Federal irrigation projects were not realized. Originally it was the policy to construct power plants on these projects only when they were needed for pumping water for the irrigation of high lands, or to furnish power used in the construction of the project works. The capacities of the plants were, accordingly, limited to these requirements.

When construction was completed and contracts for payment were made, the cost of the power plant was included as a part of the construction cost, and the water users were obligated to repay this cost just as they were obligated to repay the cost of other project works. With small plants built for construction purposes or to furnish



Black Canyon plant in Idaho has two 5,000-kva. units

power for pumping to high lands there was no reason for a distinction, so far as the rights and obligations of the water users were concerned, between these small plants and other irrigation works.

Later, however, there was an increasing need for the development of more power, beyond the actual construction and operation needs of the projects. On most projects additional power development was entirely feasible by using the head at a storage dam, drops in canals and other suitable points. Nearby towns indicated a willingness to purchase power for municipal and private purposes; the water users themselves were anxious to obtain power for domestic and farming purposes. It was recognized that where additional power could be developed its sale would not only lower construction costs, but would be a source of income and social betterment.

As before stated, the gross annual power sales from the plants on the Federal irrigation projects amounts to about $3,500,000. When the power plants now under construction are completed, and all unsold power is marketed, gross sales will amount to more than present construction repayments.

The expansion of power development beyond the immediate needs of the projects brought about a situation under which on some projects the net revenues from power development go a long way toward paying the entire construction charge due by the settlers to the government, and after the irrigation works are fully paid for these favored water users will continue to receive the power revenues as a perpetual gratuity. In the Burley Irrigation District, on the Minidoka project, Idaho, for example, the entire construction payment is about $100,000 a year. Their proportion of the net annual revenues from the Minidoka power plant is estimated at between $125,000 and $150,000, or considerably more than enough to pay the annual construction charges. After the works are fully paid for these favored irrigators will have that power profit for all time as a yearly dividend. Similar conditions obtain on the North Platte project, Nebraska-Wyoming, where the power development, although new, yielded net earnings in 1930 of $156,342 compared with annual construction charges of about $200,000. If an addition to the power plant is approved, as requested by the water users, the net revenues will pay the annual construction charges.

The radical difference in this later development of power on a commercial basis from the earlier conception of small development for purely project needs has been recognized by Congress. In recent appropriation acts special provisions have been incorporated for the disposal of power revenues on an entirely new and much more equitable basis. Instead of the revenues going to specially favored individuals as a perpetual gratuity after the works have been paid for, the revenue will go into the reclamation fund to be used for the construction of worthy irrigation projects as they are needed in the program of Western agricultural development.

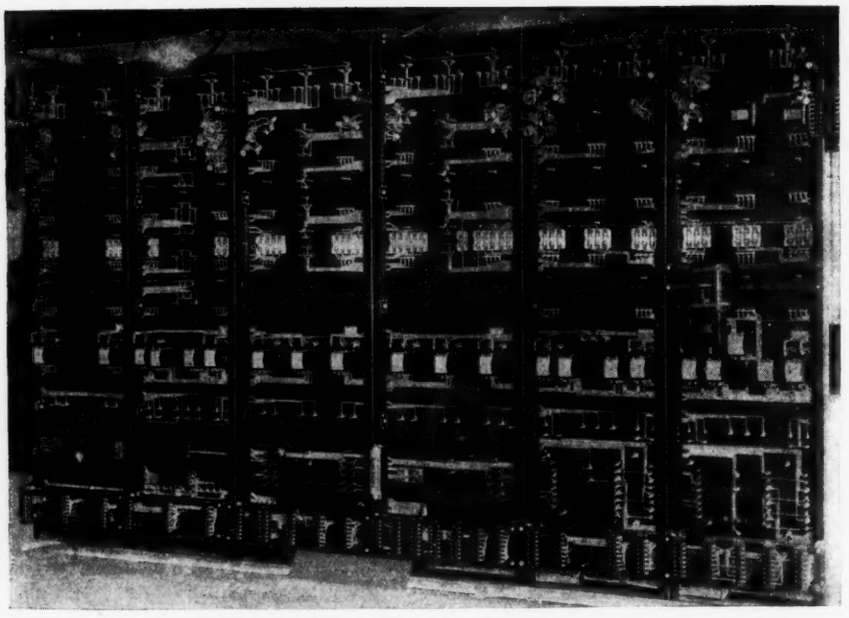
This new basis for the distribution of power revenues has been applied by Congress to several projects and will probably be extended to all future developments of power in excess of that needed primarily for construction and operation purposes. Under the new policy, power profits are applied first to repay the cost of the power plant and appurtenant works; second, the cost of the reservoir and dam which regulate the delivery of water to the plant; and after that, credited to the reclamation fund.

This change in policy as to what might be termed commercial power development does not work any injustice on the water users on those projects whose physical features lend themselves to such development. In such cases the cost of the plant is not charged to the water users, and they are not obligated to repay any part of its cost, which is taken care of by power revenues. The same is true of the reservoir and dam making the power development possible. On the other hand, the water users have benefited directly by cheaper construction. They are benefited by having cheap power for domestic and farm purposes. They will benefit by the influence such power development will have in promoting and fostering local industrial development and expansion. If Congress sees fit to enact general legislation putting the policy into effect for all future power development on the projects the reclamation fund will eventually benefit by receipts from this additional source.

POWER PLANTS OPERATED ON BUREAU OF RECLAMATION PROJECTS DURING FISCAL YEAR 1930-31

Project and Name of Plant	Outgoing Line Volts	Plant Capacity, Kva.	No. of Units	Head in Feet	First Cost of Plant	Cost of Operation and Maintenance	Estimated Depreciation	Cost per Kw.-Hr. Exclusive of Depreciation	Distribution of Kilowatt-Hours Generated: Sold to Consumers	Irrigation and Drainage Requirements	Used for Other Purposes	Losses	Total Output, Kw.-Hr.	Gross Power Sales
Boise—Black Canyon *a*	66,000	10,000	2	82- 92	$414,317.21	$14,394.23*b*	$15,291.00	$0.00034	Entire output delivered to Idaho Power Co.				42,119,956	$105,199.02*b*
Boise River *c*	22,000	1,875	3	25- 30	167,905.37	8,007.73*b*	6,144.00	0.0027	Entire output delivered to Idaho Power Co.				2,958,544	6,100.00
Minidoka—Minidoka	33,000	10,000	6	47.02	645,921.03	22,612.00	24,396.00	0.00036	22,868,580	29,861,335	6,881,692	4,157,108	63,768,715*d*	177,858.98
American Falls, (2 plants) *e*	33,000	1,540	3	36.45	76,975.00*f*									
Newlands g—Lahontan *h*	33,000	1,875	3	105–110	141,886.01	7,340.07	4,260.00		5,131,620	223,007	517,073		5,871,700	21,616.67
	66,000													
	2,300													
North Platte—Guernsey	33,000	6,000	2	70- 90	454,244.27	13,630.77	10,500.00	0.00074	24,408,568	48,930	232,919	2,942,949	18,409,000	264,320.56
Lingle	33,000	1,750	4	106	184,791.74	14,879.23	4,680.00	0.001623					9,165,470	
Rio Grande—Elephant Butte	2,300	150	1	18–180	8,440.50	2,187.27	None	0.034	None	None	64,650		64,650	None
Riverton—Pilot Butte	33,000	2,000	2	103	218,962.14	27,103.04	11,091.80	0.01668	1,113,158	None	293,272	218,460	1,624,890	21,204.91
Salt River—Horse Mesa	110,000	33,300	3	265	754,885.13	26,266.07	37,744.25	0.00033					80,390,000	
Roosevelt	110,000	19,250	7	70–240	1,235,894.58	74,635.54	61,794.73	0.00212					35,178,000	
Stewart Mountain	45,000	13,000	1	35–114	320,371.98	17,619.61	16,018.60	0.00054					32,710,000	
Mormon Flats	110,000	8,750	1	40–150	482,767.80	12,797.87	24,138.39	0.00027					43,657,000	
Cross Cut	11,000 and 40,000	5,250	6	111	755,147.29	23,324.21	37,757.36	0.00281	196,726,122*f*	57,302,239	234,779	40,201,161	3,305,700	2,686,301.72
So. Consolidated	40,000	2,000	2	34	163,139.60	11,325.64	8,156.98	0.00207					5,478,600	
Arizona Falls	11,000	1,060	2	19	109,500.73	8,742.27	5,475.04	0.00326					2,681,075	
Chandler	11,000	600	1	40	91,990.84	7,831.51	4,599.54	0.00449					1,745,920	
Shoshone—Shoshone	33,000	1,600	2	225	567,698.96	11,750.00	23,383.44	0.00191	5,367,863	None	128,950	642,721	6,139,534	76,118.97
Strawberry Valley g—Spanish Fork	11,000	1,000	2	123.5	60,904.80	20,008.77	3,045.24	0.011	1,818,979	None	192,310	252,581	2,263,870	40,355.46
Yakima-Sunnyside g—Rocky Ford	6,600	187	1	73	23,000.00	2,253.15	1,056.40	0.003	None	668,500	None		668,500	
Yuma—Siphon Drop	33,000	2,000	2	9.28	317,936.09	16,700.00*b*	13,248.00	0.002157	5,904,043	1,336,365	101,078	400,271	7,741,757*d*	60,661.70

a. Operated entire fiscal year.
b. Amount for June 1931 estimated.
c. Plant operated during July, August, and September 1930, and during May and June, 1931. Held for standby service balance of the year.
d. Includes purchased power.
e. West Side Plant operated only in case of emergency, not operated since 1927. Island Plant partially dismantled, first cost included.
f. Estimated.
g. Operated by Irrigation District or Water Users' Association.
h. Operated by Sierra Pacific Power Company under lease assigned by Canyon Power Company.
i. All eight power plants feed into the same distribution system.



Rear of steel-panel switchboard wired with asbestos and varnished-cambric insulated wire designed for this purpose

New Control Cables Have Improved Characteristics

By H. M. FRIEND

Developments made in insulated wire and cable based on recent discoveries by rubber chemists and physicists and the experimental research work of the cable manufacturers in applying these discoveries

WITHIN the last two years important improvements have been made in control cable. These may be classified as improvements in insulating materials; improvements in protective coverings; and new specifications. Insulating materials used for control cable are rubber, asbestos, and combinations of varnished cambric and asbestos. Of these rubber is the most generally used.

Rubber-Insulated Control Cable

When conditions are not severe, such as when high temperatures, chemical fumes, or fire hazards are not present and when the control cable is installed in a conduit system, rubber-insulated cable is satisfactory. When moisture is a serious factor in a conduit system, rubber is the most suitable insulating material.

Before discussing the improvements that have been made recently in rubber insulating compounds it is necessary to mention the two most important discoveries in rubber chemistry made in recent years. One of these is the use of organic accelerators in place of those of the inorganic types, such as litharge and magnesia, which had been universally employed since the days of Goodyear. By the aid of these new organic accelerators vulcanization may be accomplished at a lower temperature and in a shorter time. Besides lowering the cost of manufacture the resulting product has better physical and aging properties.

The other discovery is the use of anti-oxidants that greatly improve the aging qualities of the rubber compound. These antioxidants were developed by the rubber chemists working on the accepted theory that the deterioration of rubber with time is due chiefly to oxidation.

While there have been numerous other developments in rubber chemistry in recent years, these two great discoveries are recognized as the most important since the work of Goodyear. They are now in general use in the rubber industry and have added materially to the life of rubber products.

Recently cable manufacturers have devoted a considerable amount of work to adapting these discoveries in rubber chemistry to their rubber insulating compounds for cable. On account of the many characteristics of the compound which can be changed by varying the ingredients added to the rubber, more interest has been aroused in rubber-insulated cable during the last two years than in any recent period of equal length.

This research work by the cable manufacturers has produced rubber insulating compounds in which the inherent weaknesses of rubber, such as, aging with time; rapid aging with heat; deterioration by oils, acids and

alkalies; and injury by ozone, which is formed when corona is present, have been largely overcome. As control systems operate at voltages of 250 or less, corona-resisting compounds need not be discussed here.

The problem of reducing the inherent tendency of rubber to deteriorate with age has been studied for a long time. As applied to rubber-insulated cable this subject was attacked by one cable manufacturer some years ago before the recent discoveries in rubber chemistry by developing an insulating material that has the characteristics of a rubber compound but is softer and of lower mechanical strength than the standard rubber compounds. The composition of this insulation has been kept secret, but it is understood to consist of an oil-base compound with only a small amount of rubber added for mechanical strength. Therefore the properties of the compound do not depend on the characteristics of rubber, and it has superior aging qualities, resistance to the deteriorating effects of heat, oils, acids and alkilies as well as being less affected by corona. However, the physical properties and insulation resistance are lower than those of the standard 30 per cent rubber insulations, or the recent improved types.

In two articles on control cable in *Power*, Nov. 19, 1929, page 796, and Dec. 3, 1929, page 881, the writer

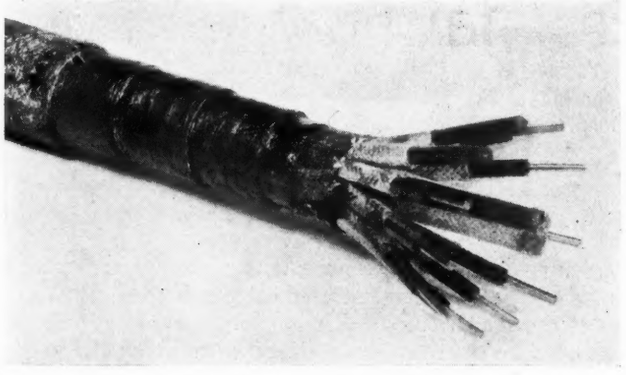


Fig. 1—Section of multi-conductor rubber-insulated control cable that may be laid directly in the ground

stated "At the present time the question of the most suitable rubber compound for insulated wire has not been settled. The fact that leading cable companies have recently developed new compounds possessing resistance qualities to ozone, heat and aging superior to the 30 and 40 per cent rubber compounds shows that there is a trend away from the old standard."

This development work on the part of the cable manufacturers and their application of the discoveries in rubber chemistry have resulted in great improvements in rubber insulation for cables. Some of these earlier developments gave compounds which, though possessing superior aging qualities and resistance to corona, were as inferior in physical properties as they were soft and mushy. Further research work, however, has improved these properties, with the result that rubber insulation is now available which has superior aging qualities, does not deteriorate rapidly with heat, is less affected by oils, acids and alkalies and has great resistance to the effects of corona; as well as possessing high tensile strength, elasticity, toughness, density (impervious to moisture) and the electrical characteristics required of the standard high-grade rubber compounds.

These new insulating compounds consist, in general, of various percentages of rubber with the new organic accelerators and anti-oxidants added to give superior qualities. In physical and electrical characteristics they meet the requirements of the standard specifications for 30 per cent rubber insulation with the exception of the chemical analysis, which they will not pass because of the presence of the organic accelerators and anti-oxidants.

To check the improvements in the aging characteristics of rubber compounds the rubber chemists have developed new tests for measuring the aging under accelerated conditions. This is necessary because to do so under service conditions would require too long. These tests depend on exposure to oxygen, usually at temperature and pressure higher than normal atmospheric.

Two of these tests are rapidly coming into general use, the Bierer-Davis oxygen bomb test and the Geer test. In the Bierer-Davis test the samples are heated to 70 deg. C. in oxygen under a pressure of 300 lb. per square inch. This test is quicker and more nearly duplicates natural aging than the other. In the Geer test the samples are heated in a current of air maintained at 70 deg. C. for 96 hr. After the samples have been subjected to these tests their physical properties are measured. The depreciation in tensile strength and elongation must not exceed certain limits. Leading specifications now include or are being revised to include accelerated aging tests made by the Geer dry-heat and the Bierer-Davis oxygen-bomb methods.

As an illustration of the improvement in the aging properties of these new rubber compounds data are given from an address delivered by Charles R. Boggs, May 13, 1931, before the Signal Section of the American Railway Association. A rubber compound conforming to the specifications of this section is given in Table I.

Table II and Fig. 2 give the results of tests made on shelf-aged rubber insulation and Table III and Fig. 3 give the results of Bierer-Davis bomb tests made to determine the effects of aging on bare-rubber-insulated wire at room temperature in the diffused light in Mr. Boggs'

TABLE I—RUBBER COMPOUND CONFORMING TO THE SPECIFICATIONS OF THE AMERICAN RAILWAY ASSOCIATION'S SIGNAL SECTION

	Percentage by Weight
Up-river, fine, dry Para rubber	32
Whiting	23
Zinc oxide	36
Litharge	5
Paraffin and ozokerite	2
Sulphur	2
Total	100

TABLE II — TEST RESULTS OBTAINED WITH SHELF-AGED RUBBER INSULATION

	Compound A[1]		Compound B[2]	
Age in Years	Tensile Strength, Lb. per Sq.In.	Elongation, Inches; 2-In. Sample to Break	Tensile Strength, Lb. per Sq.In.	Elongation, Inches; 2-In. Sample to Break
1	1,312	11.00	1,770	11.51
1	890	9.62	1,788	11.10
2	847	7.96	1,682	10.59
3	789	6.55	1,641	10.49
4	702	5.37	.....	.....

[1]Compound A conforms to the specifications of the signal section of the American Railway Association, Table I.
[2]Compound B same as A plus organic accelerator and anti-oxidant.

TABLE III — TEST RESULTS OBTAINED ON RUBBER INSULATION AFTER ACCELERATED AGING IN OXYGEN AT 300 LB. PER SQ.IN. PRESSURE AND 70 DEG. C.

	Compound A[1]		Compound B[1]	
Hours Heated	Tensile Strength, Lb. per Sq.In.	Elongation, Inches; 2-In. Sample to Break	Tensile Strength, Lb. per Sq.In.	Elongation, Inches; 2-In. Sample to Break
48	464	6.41	1,430	10.44
96	Brittle	....	1,204	10.29

[1]Compounds A and B are the same as in Table II.

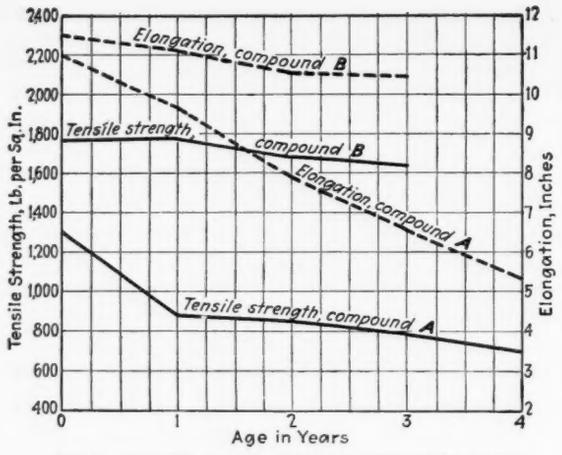


Fig. 2—Results of test obtained with shelf-aged rubber insulation

Compounds A and B are the same as in Tables II and III

testing laboratory. The physical results reported are average figures for a number of samples.

Mr. Boggs, commenting on the tests, said that comparison of the physical properties of compounds *A* and *B*, whether judged by shelf aging or by accelerated aging, shows the wonderful improvement obtained by the addition of an anti-oxidant and accelerator to the compound that the manufacturer is now required to use.

Asbestos-Insulated Control Cable

For severe operating conditions where high temperatures, acid fumes and vapors, oil, grease, or fire hazards are present asbestos insulation is superior to rubber. A standard type of this cable, consisting of a felted asbestos insulation impregnated with special compounds and covered with an asbestos outer braid, also specially impregnated, can be operated under constant exposure to temperatures up to 400 deg. F. For services such as rheostat-grid connections, open wiring in boiler rooms, wiring around chemical soaking pits, and for back-of-switchboard wiring exposed to high temperatures this type of cable is the most serviceable. The all-asbestos insulated type is made only in single-conductor cable; for multi-conductor control cable a combination of varnished cambric and asbestos is used.

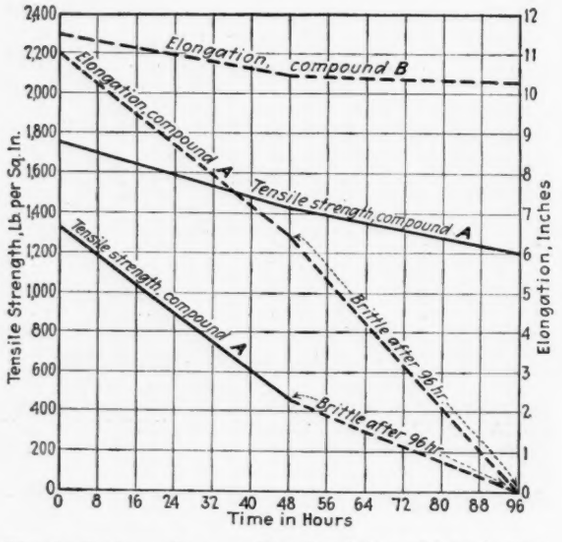


Fig. 3—Test results on rubber insulation obtained after accelerated aging in oxygen at 300 lb. per sq.in. pressure and 70 deg. C.

Compounds A and B are the same as in Tables II and III

In general all-asbestos insulated cable should be confined to open work. It may be used in conduit systems where moisture conditions are not severe, but either the combination varnished-cambric-asbestos type or rubber-insulated cable is better suited to conduit systems.

Recent improvements in all-asbestos insulated cable have been mainly in the impregnating compounds. A compound is now available that greatly improves the moisture-resisting properties of the felted asbestos and the outer asbestos braided covering. This is a black compound which is both flame- and moisture-proof. Where white braids are required the finishing compounds are flame-proof only. Research is being conducted on these impregnating compounds and improvements are soon expected to be available.

Multi-Conductor Asbestos-Insulated Control Cable

Combination asbestos and varnished-cambric insulation multi-conductor control cable is a recent improved type. For conduit installation this cable possesses the desirable qualities of asbestos for certain operating conditions and will withstand constant temperatures up to 250 deg. F. It is suitable for conduit installations, as the varnished cambric gives protection from moisture. Where sever

Fig. 4—Multi-conductor type control cable with asbestos and varnished-cambric insulation

moisture conditions are present, such as when the cable is submerged, rubber-insulated cable is better.

In the construction of this cable the conductors are stranded tinned copper insulated with a felted-asbestos wall especially impregnated. Three varnished cambric tapes are applied over the asbestos. A second layer of felted asbestos specially impregnated is then applied. Colored-cotton marker braids are woven over each insulated single conductor. The conductors are cabled with a lay and are then wrapped with a special moisture-proof tape which also prevents the outer black finishing compound from soiling the identifying braids. The outer covering consists of a heavy woven-asbestos braid impregnated with special black moisture-resisting and flame-proof compound which finishes smooth. Another manufacturer makes this type of cable with a varnished-cambric jacket replacing the special moisture-proof tape.

Improvements in Protective Coverings

In addition to the improvements in rubber insulation, the cable manufacturers have done considerable work to develop better protective coverings for cable and have recently put on the market cables with non-metallic sheaths suitable for laying directly in the ground. These cables were developed mainly to replace the parkway type that was laid in the ground without conduit and which depended for its protection on a lead sheath with galvanized-steel-armor tapes and impregnated jute coverings.

Several manufacturers have modified this type of cable for control service. These new types are so recent that they have not yet been extensively used in control sys-

tems, but they possess characteristics which make them superior for certain services and they allow the design of a control system where the control cable is laid directly in the ground without conduit. This type also offers another choice for use in a conduit system in place of the conventional types of lead-sheathed or weather-proof-braided cable. Difference of opinion among engineers regarding the relative advantages of lead-sheathed and weather-proof-braided cable in conduit systems may lead many installations to adopt the new type with non-metallic sheath as it offers better protection than the weather-proof-braided type without the disadvantages of lead.

Several manufacturers have put on the market cables of this type. While differing in construction details, they all depend on moisture-resistant rubber compounds and non-metallic protective coverings. The conductors for this new type of cable made by one manufacturer

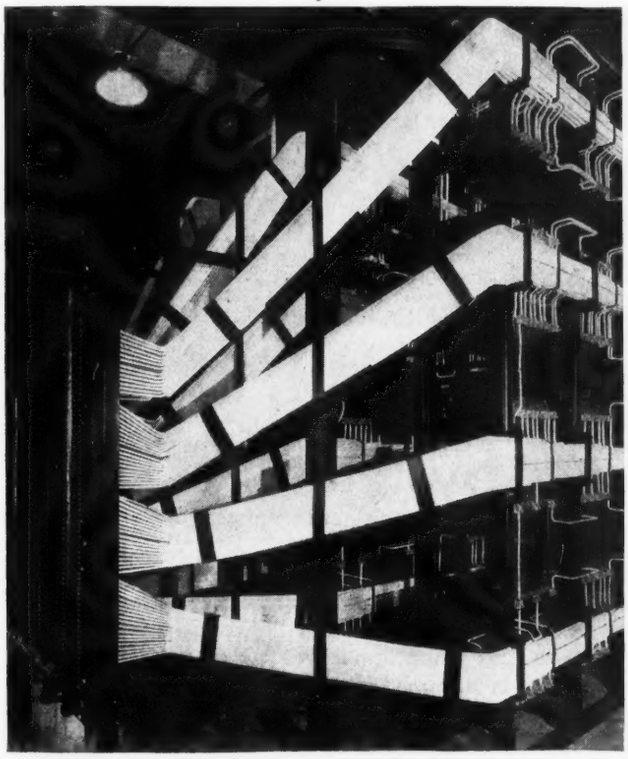


Fig. 5—Over 12,000 ft. of asbestos insulated wire was used to connect the control of this rheostat to the resistance grids

are soft tinned copper. The insulation consists of intermediate-grade rubber that has good aging qualities and a thickness in accordance with A.I.E.E. specifications. A colored cotton braid for identification is placed over each insulated single conductor and coated with a clear moisture-proof finish. The individual conductors are cabled with a lay, and paraffined jute is used to round out the cable. Where conductors are numerous and consist of a core and outer layers a single-faced rubberized-cloth tape is applied over the core portion and over each subsequent layer. To protect the colors in the outer layer of conductors a single-faced rubberized-cloth tape is wrapped over each of these conductors. The valleys between individual conductors of the outer layer are filled with an asbestos-base calk that provides a seal over the entire surface of the assembly. An asbestos-braid sheath $\frac{1}{16}$ to $\frac{3}{32}$ in., depending on the diameter of the cable, thoroughly impregnated with a saturant and covered with a seal of the asbestos base calking material is next applied. Two wraps of kraft armor tape are wrapped in opposite directions, making a wall at least 0.060 in. thick. A layer of the asbestos-base calk is placed over this armor to provide a moisture-proof seal. An outer covering consists of pre-saturated asphaltum-filled jute finished with special impregnating compounds and dusted with soapstone. When this cable is to be used in conduit, where it is unnecessary to provide so much mechanical protection, the outer covering is simplified.

The protective properties of this cable depend mainly on the calking material, the asbestos braided covering, and the protecting kraft armor tapes. The calking material was developed by research. It is claimed that it is impervious to moisture and the attack of earth acids and earth alkalies, and that it is practically inert and remains in a plastic state even at freezing temperatures. The asbestos sheath filled with the calking material takes the place of the usual lead sheath. It is claimed to be unaffected by electrolysis and is not subject to induced-current sheath losses, is not subject to crystallization and other defects inherent in lead. The kraft armor tapes which are saturated are claimed to be impervious to decay or oxidation.

This article has not attempted to cover all the improvements in rubber insulating compounds which have been made, but has merely touched on the most important ones. The next few years will undoubtedly show additional improvements in control cable insulation and construction.

The author wishes to thank the Rockbestos Products Corporation, New Haven, Conn.; and the General Cable Corporation, New York City, for their assistance in the preparation of this article.

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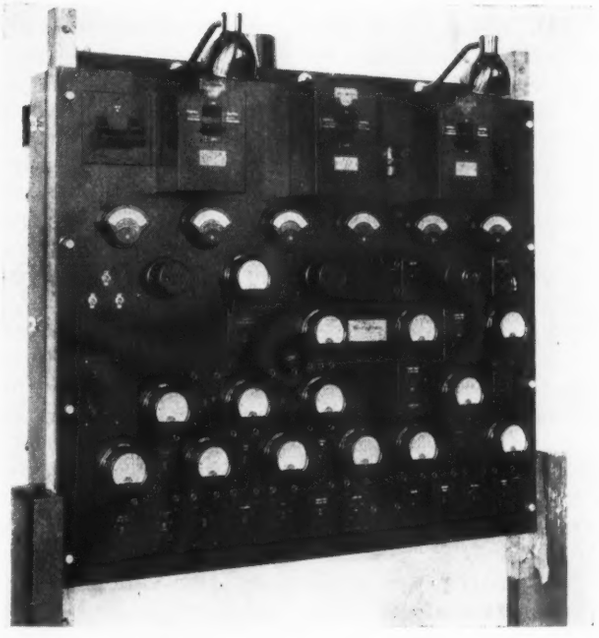
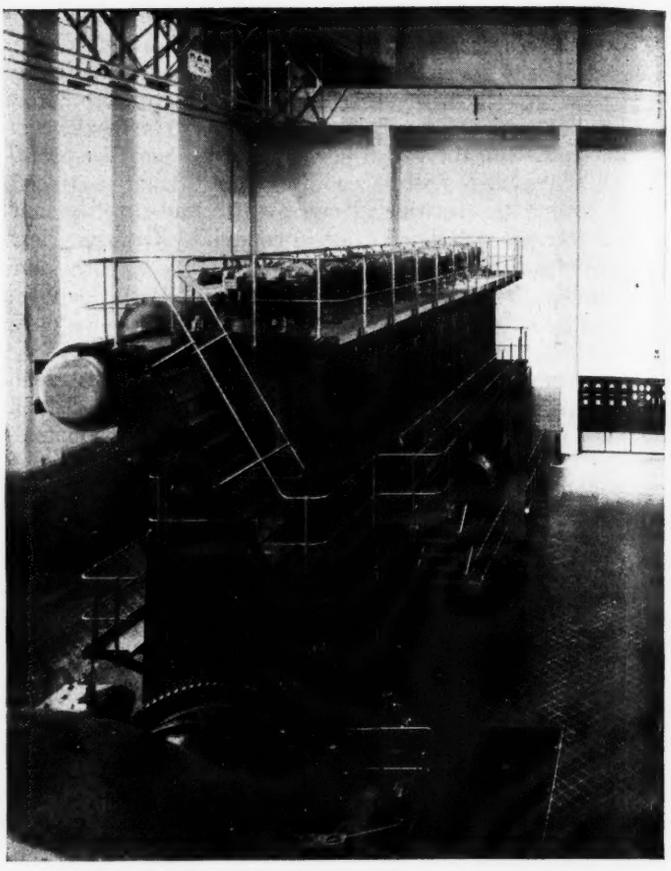
Controlling the Akron



This diminutive Westinghouse switchboard on the navy airship Akron, 42 in. wide, 35 in. high and 12 in. deep, with its 2,170 ft. of wire, controls all the power and lighting circuits of the ship. It weighs only 200 pounds



The Hennegsdorf substation of a Berlin, Germany, utility contains two 11,700-hp. diesels connected to generators which may be run as synchronous condensers

One of the most attractive phases of oil engine application is its use as auxiliary power to central power systems. The diesel may serve as a peak-load carrier, as a generating unit at the end of a transmission system, or as a protection against service interruption in an industrial plant or office building

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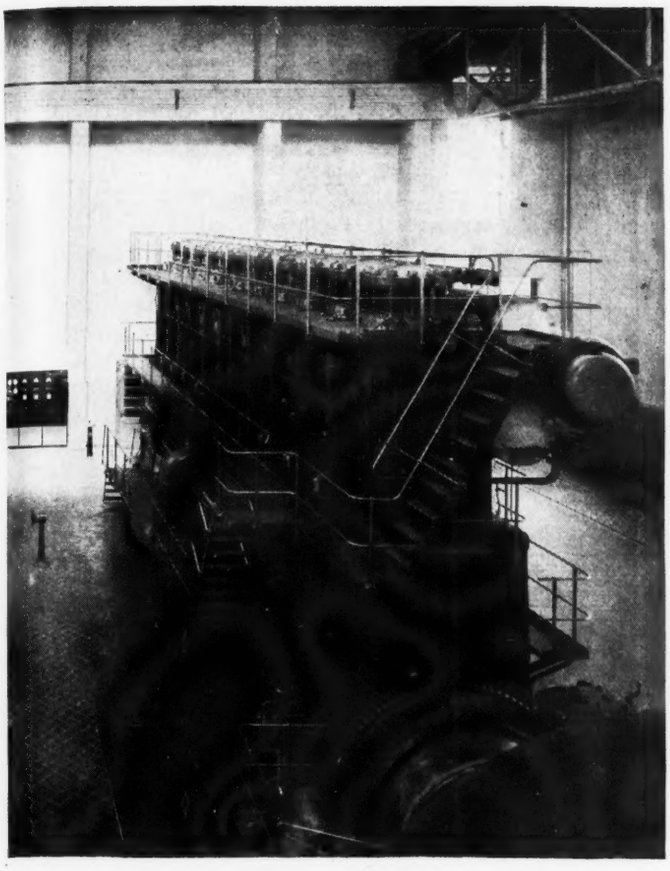
The Diesel as an Auxiliary To Central Power Systems

IN CONSIDERING oil engines as auxiliaries to power networks it is desirable to define what is meant. This discussion concerns the application of diesels where the service might be performed by taking power from some other prime mover, steam, oil or hydraulic, through transmission lines already available, or which could be made available. The problem is whether the best service at a given location can be secured from the power network, from a local diesel plant, or from some combination of the two. The question of who owns and who operates the oil engine units is a subsidiary one. This study does not concern locations where other power supply is not available.

Starting at the central generating station, but not considering the main generating units, which have been discussed in a previous article [*Power*, Oct. 27], there are cases where the diesel has advantages for supplying the auxiliary services. Generally speaking, in this country the auxiliaries are driven by steam turbines or electric motors in the steam station and by electric motors in the diesel stations. Just as there has been an increase in the use of diesels for auxiliary service on large steamships, there would seem to be an opportunity to develop their use in land stations, particularly those having a small number of main units or lacking interconnection, so that there would be advantages in having an independent power supply for the auxiliaries.

The second, and much more important, application within the central station system is in substations. Due largely to the rapid growth of the central station industry in this country, and our confidence in the future, it has become a habit to build transmission lines and substations of ample capacity for several years' anticipated growth. Owing to the high potential employed, it has sometimes happened that the smallest transmission line that it is feasible to build has more capacity than the anticipated requirement for some time to come. Costs of distribution, including line and substation losses as well as other items, are being studied more carefully now and the question of over-all cost of an auxiliary prime mover at some substation location, compared with transformer and transmission line capacity ample for maximum load, and insurance against interruptions in service, is being examined. As was pointed out in the article on "The Large Oil Engines for Central Stations Service," in the Oct. 27 issue, oil engines of 7,000 hp. and less have proved themselves reliable, and the next step up to 25,000-hp. units is now being taken. There is a large number of diesels of 2,000 to 3,000 hp. in central station service all over the world, to say nothing about many more smaller ones.

The problem is therefore an economic one, because technically there is no difficulty in arranging an oil engine substation that will be as reliable as a transformer substation, having in mind that it is independent of transmission line failures which would render a transformer sta-



BY OLIVER F. ALLEN
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tion inoperative. Where the load factor is such that the uility factor of the transmission line would be low, or a change in load would overload an existing transmission line during only a few hours per day, or if a substation is at the end of a long single line where interruptions of service would work undue hardship on customers, the diesel is indicated as a good solution. It is true that the transformer substation can be made wholly automatic, thereby saving the losses of all transformers not actually required by the load, and reducing labor charges to a minimum. When there are two or more lines feeding the substation it can be protected automatically so as to continue uninterrupted service so long as at least one line remains intact.

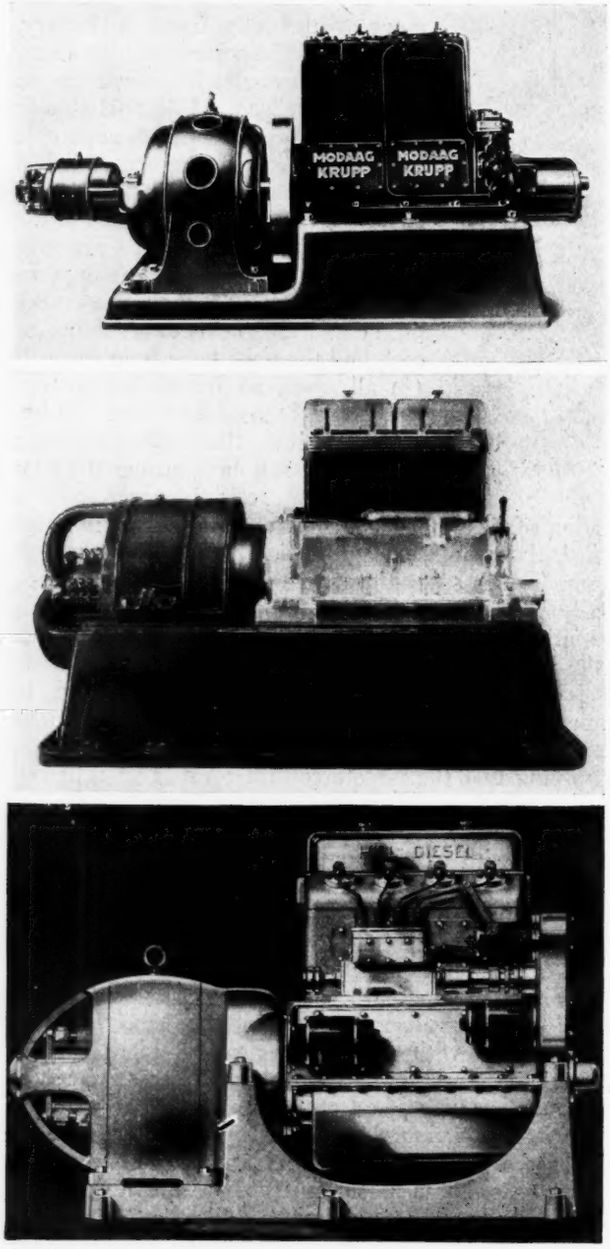
The problem of making oil engine plants automatic or semi-automatic has only recently been studied seriously. The first move in that direction was to equip the diesel with the same sort of protective devices having to do with overspeed, failure of lubricating supply, failure of fuel supply and overheating if parts as have been successfully applied to steam turbines and motor-generator sets. Another step was remote control of rotative speed to facilitate synchronizing units from switchboard control stations. This development was perfected on locomotives and rail cars before being applied to stationary engineers. There are several types of diesel-electric locomotives, both in this country and Europe, and some mechanical drive locomotives and rail cars in Europe, in which the motorman does not have access to the engine compartment while the train is in regular service. The entire control of the engine is from the operating cab. These applications comprising complete remote control are so numerous and so successful that engineers should not hesitate to lay out substations with large oil engines to be started, synchronized, operated and stopped from a distant control station.

The final step of making the plant fully automatic, that is, starting, controlling the operation and stopping of the diesels without any human intervention, is comparatively new. It started with a combination of one unit and a storage battery, like the gasoline engine lighting plants in general use in farm houses. The next step was to provide two or more diesel engines, with or without a battery, which would be automatically started, stopped and controlled, according to variations in load. This final step in making the diesel plant automatic was, it is believed, first accomplished in England by The Lister people, and has more recently been studied in the United States by Strong, Carpenter and others. Here again the applications are so recent that there are very little data available as to reliability or cost, and the units have been so small (in all cases, so far as known, engines have been of less than 100 hp. capacity) that the fully automatic plant must still be considered as an experiment. It is, however, only a question of a few gadgets similar to those used in automatic hydro plants, on automatic rotary converters and in transformer substations, to be added to the features already incorporated in the remote-controlled plants on locomotives. It would therefore seem that just as soon as the central station owners demand fully automatic diesel substations the industry will be prepared to supply reliable equipment the cost of which should not be excessive.

Granting that the remote control plant is an actuality and that the fully automatic plant is something in the very near future, it is apparent that the oil engine can be utilized with a minimum of attendance not only in substations of power networks, but on customer's premises, either to take the place of the central station service or to augment it.

This brings up the much mooted question of the completely isolated plant where central station service is available. This again is an economic problem. Like the central station with diesels, the isolated plant can be made reliable, and there are cases, particularly if heating or processes requiring heat are involved, where the owner is justified in having the isolated plant, irrespective of any likely price at which central station service would be available. These instances are, however, believed to be rare and the author's experience indicates that a combination of central station service and local plant gives the most generally applicable solution.

There has been a feeling, not only in this country but also abroad, on the part of central station operators, both private utility and municipal, that it was to the interest of the central station system to suppress all private plants where service could be supplied from its lines. At the present time, when rate-making necessitates uniform rates for each class of service and the central-station people are more interested in securing the most efficient and economical service for their customers, this situation is being looked at differently. It is recognized that in some cases the requirements for non-electrical services justify a local plant which can provide some heat. There are other cases in which the cost of increasing feeder capacity to meet customers' requirements for maximum load and reliability would go a long way toward paying the first cost of the oil engine plant on the customer's premises, and sometimes the transmission losses would contribute much toward equalizing the delivered cost of current with the local plant production cost. There are, finally, those cases where a particular customer, especially when owning the premises, has such a load as to permit the production of current by a local diesel plant at a substantially lower cost than the authorized rates of the utility for the class to which the customer belongs.



Small diesels suitable for stand-by or automatic plants

If an intelligent study of the problem indicates that in any of these cases the diesel auxiliary plant is economically justified, the next question is, who shall install it, and who shall operate it? Heretofore such a question would have been laughed at. It has always seemed to be the user who must install and operate such a plant. It is only now being recognized that manufacturing and furnishing of electric power is a specialized service just as much as is operating a railway or a bakery.

It is noticeable that most of the recent large projects for railroad electrification have not included the building or operating of generating stations by the railroad, but have provided for purchasing all of the power from utility networks. It might be said that the staff of a railroad is quite well qualified to operate an electric-generating station, but it can hardly be said that the normal staff of a department store, a hotel, a warehouse or even an industrial plant is as well qualified to operate a generating plant as is the staff of a central-station system. Of course there are exceptions where one finds the local staff operating plants in department stores, hotels, office buildings and industrial plants just as intelligently and fully as efficiently as the staff of the largest system operates its plants. The point to be emphasized here is that the principal business of the central station is generating and distributing power, while that of the hotel, department store or industrial plant is doing something entirely different. So the management should always be free to devote its attention to its principal business, either by departmentalizing its power plant and services or purchasing its power.

This feeling has begun to show itself in various places, and there are some cases where the utility, either directly or indirectly, is operating plants on customer's premises. This is seen in many cases where heating arrangements are made and carried on by the utility operating a central heating plant or operating plants on customer's premises.

There are cases of cooperative operation where the plant is run by the customer, but is operated in conjunction with the central station in such a way as to distribute the load to the best advantage of both. A good example of this is Harrod's Department Store, in South Kensington, London, England. This organization has in its oldest and main building about 1,000 kw. of steam capacity. In one of its newer buildings, on another street but connected by tunnels, is a diesel plant, also of 1,000 kw., with exhaust gas boilers supplementing the jackets to supply hot water as a byproduct of the diesel plant. The third source of supply is a central station system. The winter peak load is a little over 2,000 kw., and the maximum demand on the central station is adjusted so as to make a minimum requirement on it during the holiday season, when its other load is high. The lack of need of steam in the summer permits virtual shutdown of the steam plant, so that its output and the load of the diesel plant is adjusted to take a substantial amount of current from the central station at the season of the year when its other load is relatively small.

By intelligent distribution of load between these three sources of supply, giving due consideration to the heating requirements and to the central station's need of load, the costs per year are lower than they would be if the entire requirements were supplied by any one of these three sources. This diesel plant operates without creating any nuisance in the neighborhood.

Another example of a large diesel plant in a department store which is in no way a nuisance is the plant of R. H. Macy & Company at Broadway and 34th St., New York City.

By utilizing automatic or semi-automatic features and arranging for servicing of the same general character that is being supplied for elevators and refrigerating machines, there is no reason why the small diesel installation on a consumer's premises can not be made to operate satisfactorily without the regular employment of expensive personnel. There has been good ground for complaint regarding some diesel plants which have been operated by unskilled labor without protective devices and without supervision or an adequate service organization. Obviously there is no more reason for expecting a diesel plant to operate successfully without intelligent supervision than there is to expect an automobile to run well indefinitely without being taken to a service station to be cleaned, greased and adjusted by people skilled in the work.

Generally speaking, the question of installing a diesel plant on customer's premises is not one of the comparative cost per killowatt-hour of the production of the current. It is only in rare cases that such a local plant can generate current as cheaply as a central station. It is sometimes a question of the cost of the current from the central station delivered at the customer's premises in sufficient quantity and with the reliability essential to good service without interruption, and sometimes only a question of the rate that can be legally quoted. It may also be a question of how much the customer would have to spend for some auxiliary service, after purchasing electric power, which he would not have to spend in the case of the local plant.

If these various aspects of the problem are studied intelligently and sympathetically by the customer and the central station management together an economic solution can be arrived at, and in a substantial number of cases it is believed that a local diesel installation would be indicated. The final question as to who shall install and operate it must then be answered, because if the local plant is not operated so as to be reliable and as economical as the central station service it should not be installed.

[This is the third of a series of articles the first of which appeared in the Oct. 13 number and the second in the Oct. 27 number. Others will appear in subsequent issues; particular attention will be given to European developments.]

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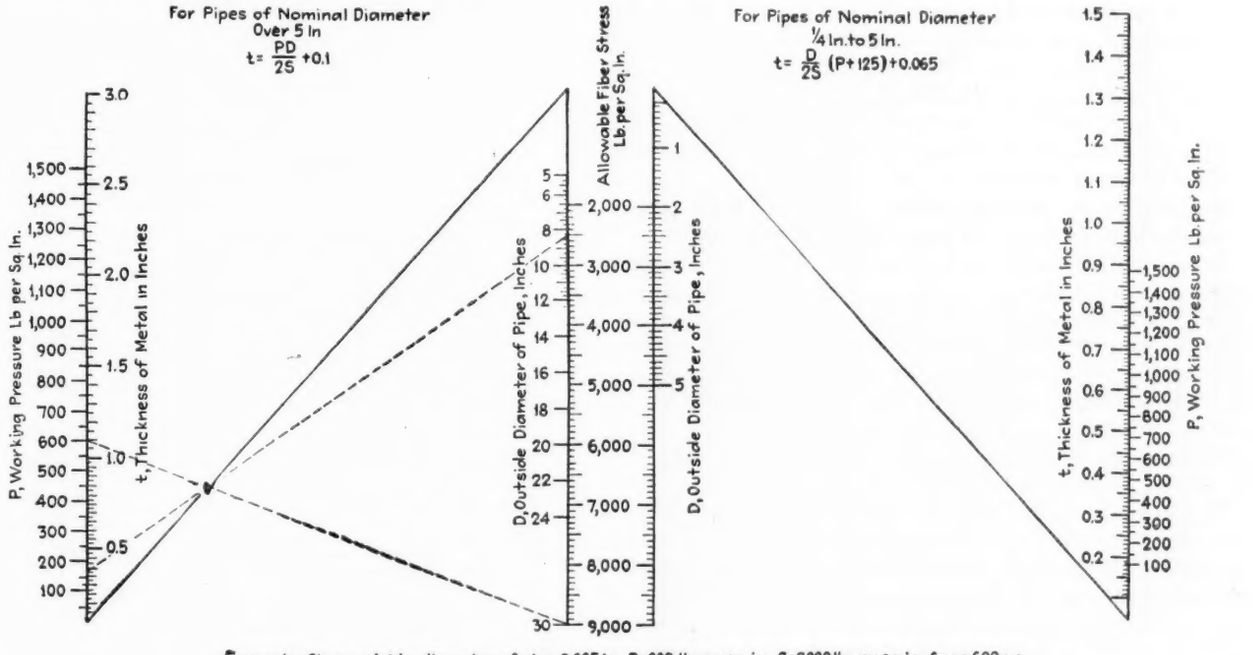
Chart for Determining Thickness of Pipe

By C. V. JENKINSON

THE accompanying chart gives the thickness of pipe as found by the Barlow formulas. The right-hand chart gives data for pipes of sizes ¼ to 5 in. inclusive, and the left-hand chart is used for pipes above 5 in. The method of use is shown by the example given on the chart. The values of S, or the allowable fiber stress for the different kinds of pipe, are given in the table.

Kind of Pipe	Lb. per Sq.In.
Seamless steel	S = 9,000
Lap-welded steel	S = 7,000
Butt-welded steel	S = 5,000
Lap-welded wrought iron	S = 5,300
Butt-welded wrought iron	S = 4,500
Brass	S = 4,500
Copper	S = 4,000
Cast-iron	S = 3,000

The chart has been found useful when calculating stresses and reactions induced by thermal expansion in pipe lines. In this case it is necessary to add the hoop stress to the fiber stress induced by expansion. The former may be found from the chart for any pressure and thickness of pipe, and when added to the calculated expansion stress gives the maximum combined stress in the line.


For Pipes of Nominal Diameter Over 5 In
t = PD/2S + 0.1
For Pipes of Nominal Diameter ¼ In. to 5 In.
t = D/2S (P + 125) + 0.065
P, Working Pressure Lb per Sq. In.
t, Thickness of Metal in Inches
D, Outside Diameter of Pipe, Inches
Allowable Fiber Stress Lb. per Sq. In.

Example: Given outside diameter of pipe 8.625 in., P=600 lb. per sq. in., S=9,000 lb per sq. in., from 600 on pressure scale run line to 9,000 on stress scale, from 8.625 on diameter scale run second line through diagonal at intersection of first scale and continue to thickness scale, the thickness given is 0.3875 in. Thickness of piping - A.S.M.E. standard

Chart gives thickness of pipe as found by the Barlow Formula

Draining High-Pressure Steam Mains

In high-pressure plants as few traps as possible are installed, while some engineers advocate eliminating them altogether

IN ANY system of steam piping provision must be made for removing water that may collect in the pipe from separation of moisture in the steam, slugs of water coming over from the boiler or condensation due to heat loss through the pipe covering. This applies equally to superheated as well as saturated steam lines, as it is entirely possible for water to flow along the bottom of a pipe with superheated steam above it. If such provision is not made the water may cause considerable damage to the turbine or engine supplied by the system.

The design of a drainage system for the main steam piping in a power plant must consider two operating conditions that require widely different drip capacities. When a cold steam line is being warmed prior to cutting it in for regular operation the rate at which steam condenses is great, and correspondingly large drains must be provided to remove the large quantity of condensate formed. Once the line is fully heated, however, and steam is flowing to the various units the quantity of condensate normally to be removed is by comparison exceedingly small.

The process of warming up a cold line occurs relatively infrequently, and therefore the installation of traps of the large capacity required for this service cannot generally be justified. Consequently open blows are provided and the condensate and steam wasted.

Open blows should be provided for every section of the steam main or branch that can be isolated and shut down. Such open drain connections are generally made at the sectionalizing gate valves and are usually of 1- to 1½-in. pipe. Double valves should be provided, and the discharge, for safety reasons, should be piped to a convenient sewer or receiver.

In addition to the open blows, steam traps or other drainage system must be provided that will automatically remove any condensate that may collect while the steam line is in operation. The location of trap connections along a steam main depends almost entirely upon the arrangement of the line in question. Generally a trap is connected at or near the throttle valve of the engine or turbine unit, but if a separator is installed the trap connection is made to the separator drain. The only other general rule that can be given is that all pockets in the steam lines should be trapped.

The capacity of the traps to be installed on any given line cannot be determined even approximately by any basic calculation. This will be obvious from the following consideration: If dry or superheated steam is delivered by the boiler the condensation that takes place in the steam line will be due to the heat loss from the pipe by radiation. This quantity can be calculated, but with modern insulation it will be found to be very small. The traps, however, should be capable of discharging the water that may collect under such emergencies as a priming boiler. The amount of water to be removed under such circumstances cannot be definitely predicted, and thus the selection of trap capacity becomes a matter of judgment and experience. An empirical rule sometimes employed is to provide a trap capable of discharging five to six times the calculated condensate due to radiation and to moisture carried by the steam if a saturated steam line is involved. Application of this rule should be modified to take care of local and special conditions. Traps should not be specified by the size of inlet or discharge but by the quantity of drip they are to discharge, as traps of different manufacture having the same pipe sizes often differ widely in capacity.

The traps used for high-pressure steam line drips are practically always of the bucket or ball-float type. In selecting the make of trap consideration should be given to freedom from wire-drawing, to freedom from possible binding of the operating mechanism, to the means provided for collecting and removing scale and dirt, and where high temperature are used to the material employed in the seat disk and other trim.

Traps should be as close as possible to the pipe they drain and in such position that their maintenance will not be difficult. By placing the traps close to the pipe

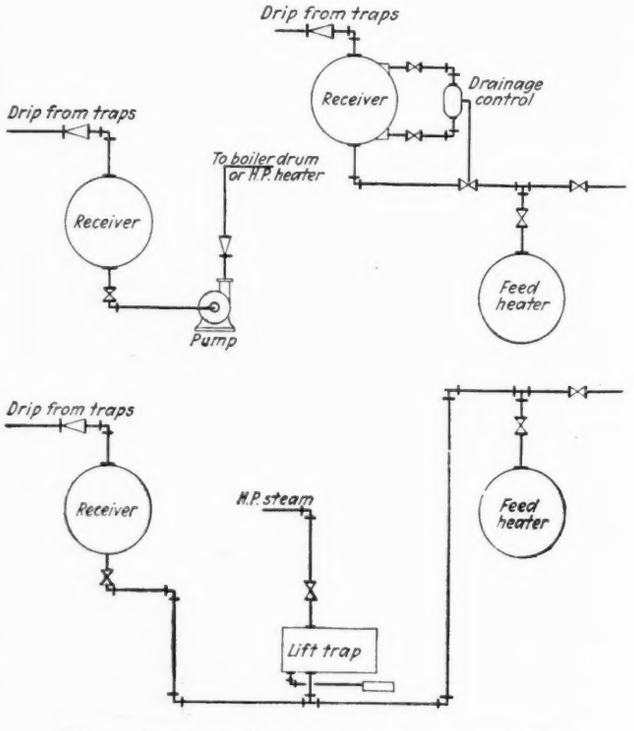


Fig. 1—Some methods of disposing of trap discharge

a long pipe connection where additional condensation of steam may occur is avoided.

The connection to the main should be double-valved and the trap should be provided with a bypass so that the steam line can be dripped while trap repairs are made. Particularly where high temperatures exist precaution should be taken to provide ample flexibility in the pipe connection between the trap and the main and in the bypass connection. Fig. 2 shows a trap connection employed at a recent high-pressure station.

When convenient the discharge lines of traps connected to mains of practically the same steam pressure are run to a common header. When this is done a check valve should be placed in the discharge line from each trap close to the trap to prevent steam from higher-pressure points blowing back through traps draining steam lines at slightly lower pressure.

Drips from high-pressure traps are generally collected in a receiver tank built for that purpose or in the reservoir of an open feed-water heater. In either case the drips are introduced above the water level to insure against water-hammer. When a special receiver is employed ample vent capacity should be provided so that the flash steam may be discharged either to a feed-water heater or to the atmosphere.

Receivers may be drained in a number of ways. Pumps under float or manual control may be arranged to deliver the drip to the main condensate system or to the boiler drums. If the receiver can be placed above the feed-water to which it is vented the drips can be discharged by gravity to the heater through a drainage control system. A lift trap may be used to discharge the drip from the receiver to a high-pressure heater or to a second receiver placed above the boiler drums, from where a second lift trap can discharge the drips directly to the boiler drums. This latter arrangement generally is used only in small plants.

The advent of high-pressure plants has brought about a tendency to avoid the use of traps for steam line drips. In some plants this has taken the form of installing a minimum number of traps. For example, one plant with two high-pressure units has only three traps on the high-pressure main steam piping. In other plants traps have been eliminated altogether.

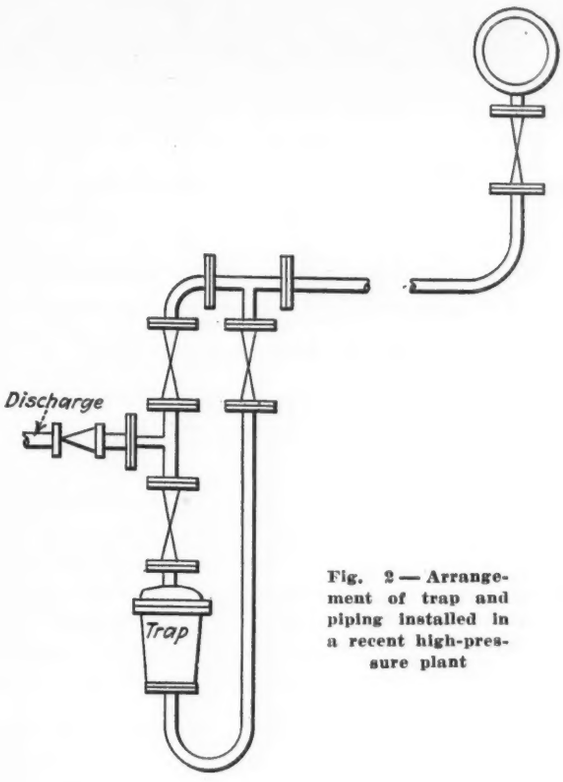


Fig. 2 — Arrangement of trap and piping installed in a recent high-pressure plant

For lower pressures the steam loop has been used in lieu of steam traps. However, this sytem cannot be used in high-pressure plants because of the large drop in pressure that usually exists between the boiler drums and turbine. This necessitates installing the second receiver of the steam loop system at an impracticable elevation above the boiler drums in order to obtain sufficient gravity head to return the drips to the boilers.

A system now being installed in an addition to a large utility plant utilizes a closed receiver tank to which the various drip lines are run. Traps are not installed, but check valves are placed in the lines close to the receiver tank to prevent back flow and to provide ample head to open the checks. The tank drain is provided with a suitably sized orifice which permits steam and drip to flow to the steam space of a closed heater and breaks down the high pressure to that in the heater. The orifice is sized so that it will discharge all the condensate that may be formed and at the same time limit the amount of steam passing to the heater when the rate at which drip collects is less than the capacity of the orifice. It is recognized that in such a system a loss of thermal head is experienced, but the heat in the steam and drips is conserved. It is felt that the cost of this loss in thermal head is more than offset by the absence of trap maintenance.

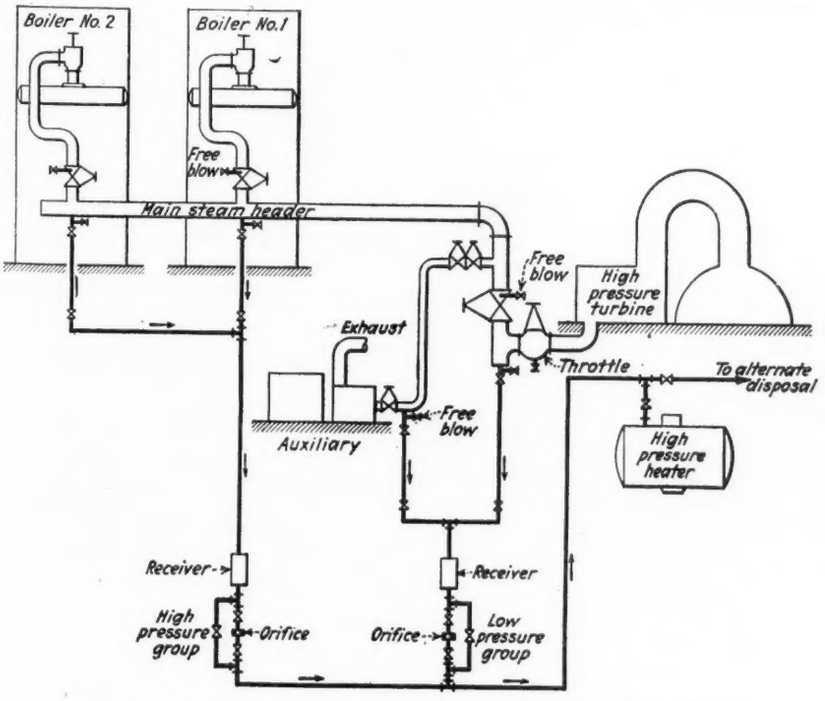


Fig. 3—A high-pressure drip system using orifices and no traps

Mechanical Features of Turbines at Bremo

By J. D. SCHMIDT
Westinghouse Electric & Manufacturing Company

The turbine units at the Bremo station are the largest 3,600 r.p.m. machines installed in the United States, but units of the same capacity and speed have been operating in Canada and Europe

THE MAIN UNITS in the Virginia Electric Company's Bremo station consist of two identical tandem compound turbines of 15,000-kw. capacity each at 80 per cent power factor, operating at 3,600 r.p.m. and producing three phase 60 cycle current at 13,800 volts. They are designed for steam conditions of 450 lb. pressure and 825 deg. F.

In general arrangement these sets are of the usual type consisting of a single flow impulse and reaction high-pressure cylinder and a double-flow reaction low-pressure cylinder; the latter connected by a solid coupling to the generator, with which it forms a three bearing unit. The general construction is shown in Fig. 1.

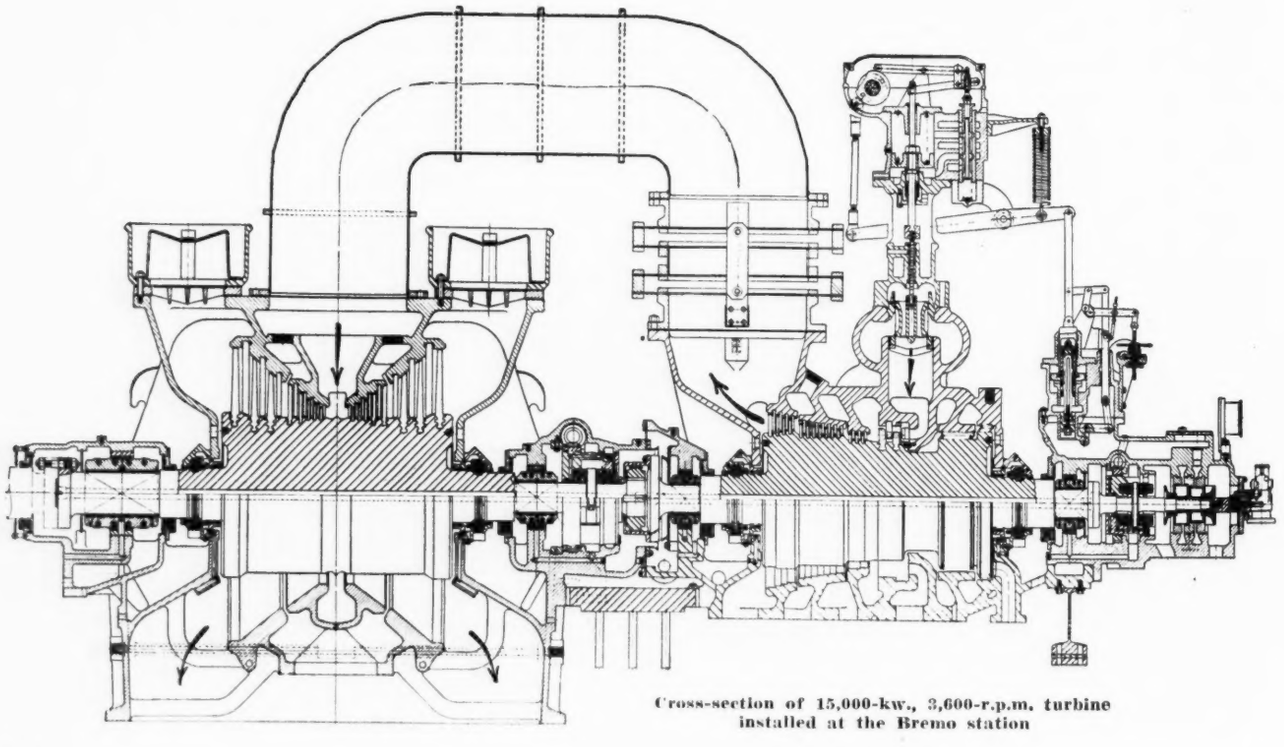
The low-pressure turbine is supported on a flange or chair, integral with the cylinder base and extending its full length. This flange is free to move in any direction to accommodate expansion of the cylinder. Transverse displacement of the centerline is prevented by means of keys at either end and the unit is anchored at the forward end against longitudinal movement.

The exhaust end of the high-pressure cylinder is supported by brackets at either side resting on machined surfaces on the low-pressure turbine bearing pedestal, upon which they are free to slide. The exhaust end is secured against axial movement while the inlet end is supported on an I-beam the web of which provides sufficient flexibility to permit longitudinal expansion. Sidewise movement of the exhaust end is prevented by a key, as in the case of the low-pressure turbine.

The low-pressure and high-pressure turbine bearing pedestals are connected to each other by means of a diaphragm joint, which permits a reasonable degree of relative motion of the parts. Each element has its own Kingsbury thrust bearing and the rotors are connected by means of a sliding coupling. Both turbine thrust bearings are provided with means for adjustment of the axial blade-clearances.

The turbine rotors are each made from a single forging and are solid save for an inspection hole through the center of each, through which the quality of the material was carefully checked by means of a special microscope provided with powerful illumination. The thrust collar, governor impellers and automatic overspeed trip on the high pressure turbine, are mounted on a stub shaft bolted to the end of the rotor proper.

The governing mechanism employed is of the centrifugal-oil-pump type. The governing force is the variation in pressure of oil delivered by an impeller mounted on the turbine shaft, and is applied to a spring loaded relay which controls the movement of the operating piston. The latter is connected by linkage to a countershaft whereon are mounted cams that control the action of individual hydraulic operating mechanisms for each of three inlet valves located in the cylinder cover. The usual



Cross-section of 15,000-kw., 3,600-r.p.m. turbine installed at the Bremo station

mechanically driven main oil pump is replaced by an oil ejector, motive oil for which is supplied by one of the impellers and which draws oil from the reservoir and delivers it through the cooler to the lubricating system.

Steam from the inlet valves passes through the nozzles to a two-moving-row velocity-compounded impulse stage and thence through three groups of reaction blading to the high-pressure turbine exhaust. Steam from the high-pressure cylinder is led through an overhead receiver pipe to the low-pressure turbine and thence to the condenser. The receiver pipe is provided with one double expansion joint of the diaphragm type supported by two link struts.

In order to obviate the inconveniences and complications attendant upon the provision of atmospheric relief valves adequate for safeguarding the exhaust chambers, suitable apertures are provided in the cylinder cover. They are closed by means of lead diaphragms designed to rupture at a pressure lower than the maximum safe internal pressure in the exhaust space. These may be seen in the sectional view of the turbine. As a protection against possible injury or scalding of the operating personnel, pot-shaped guards are provided to direct the blast of steam upward. Although the replacement of a ruptured explosion door requires some little time, it should be remembered that a condition in the condensing system which would cause the unit to go non-condensing and rupture the diaphragms, would almost inevitably require more time for correction than that needed for their replacement.

Provision is made for feed heating in three stages, two of the extraction openings being located in the high-pressure element and one in the low-pressure.

The turbine blading is of stainless steel throughout and that in the high-pressure element is of the axial clearance type often called "end tightened." These blades are shrouded and provided with a base strip so that the shroud of the stationary row will be close to the base strip of the moving row, and vice versa. The axial clearances between these parts are established by "grinding" the shrouds against the base strips, after which the clearance may be closely controlled by manipulation of the thrust bearing adjustment. A running position and a start-and-stop position are established in the thrust bearing, by means of suitable liners and stop pieces when the clearances are adjusted in the initial operation of the unit. The desired position of the rotor may thereafter be obtained by turning the thrust adjustment as far as it will go, in the proper direction.

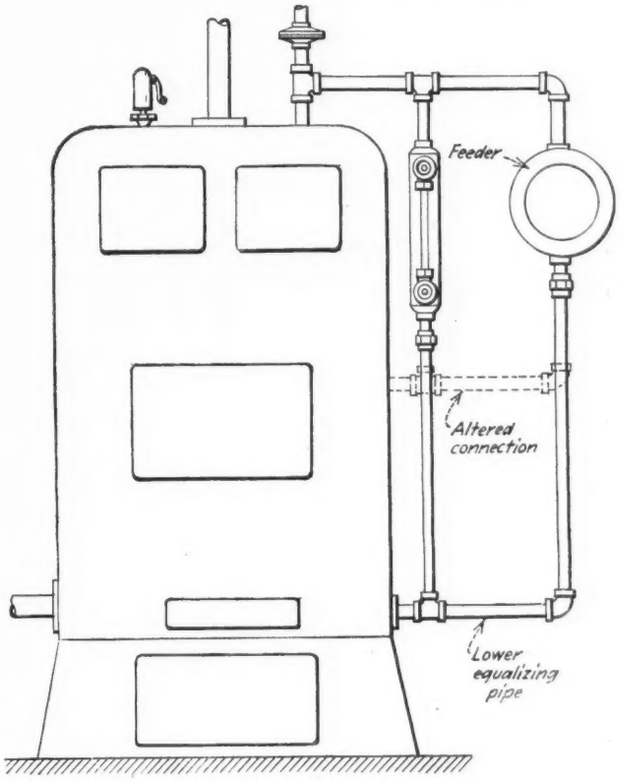
▼

Improper Feeder Connection Floods Heating Boiler

By J. D. ARNESTER

ONE OF THE buildings belonging to a manufacturing plant stood remote from the power house and group of buildings which formed the principal part of the establishment. A low-pressure cast-iron boiler, fitted with an automatic water feeder, was installed to provide heat for this building. The installation worked well during the first winter it was used, but an addition of 25 per cent more radiating surface put a heavy overload on the system. In cold weather the boiler had to be forced unduly, and this produced a condition described as "flooding"—the water level rising suddenly from 2 to 5 in., with the water often spouting through the safety valve.

At first the trouble was ascribed to defective arrangement of the main piping, it being assumed that the condensate remained trapped in the return lines until the steam pressure fell low enough to permit a big bulk of it to flow with a sudden rush to the boiler. But an examination of the system showed that all of the return pipes were of ample size and properly connected, with a downward pitch toward the boiler even greater than the 1 in. in 10 ft. usually considered sufficient. The



Raising feeder connection to boiler stops flooding

water feeder also appeared to be in good working order, the delivery valve being perfectly tight against the pressure carried. It was concluded therefore, that the trouble lay in the connections between the boiler and the feeder.

The general arrangement of the boiler and its appurtenances is shown in the accompanying sketch, the position of the feeder relative to other parts of the apparatus being altered somewhat to facilitate illustration. As originally installed, the lower equalizing pipe joined the boiler just above its base. This connection was changed to tap the boiler about midway of its height, as indicated by the dotted lines in the sketch. That stopped the flooding.

The trouble was explained on the theory that when the boiler was forced the circulation through the lower equalizing pipe, as originally connected, was so rapid as to produce a siphoning effect on the feeder. Owing to the abnormal lowering of the water level in the feeder which thus occurred the delivery valve opened to its fullest capacity and let much more water into the boiler than was needed. With the altered connection the circulation was not so rapid as to destroy the equilibrium between the water levels in the boiler and the feeder.

Fig. 1 — Precipitation gage

Air pollution in congested areas, with its consequent effect on the health and general cleanliness of the community, is largely due to emission of solid impurities from smoke stacks. The first step in the reduction of such pollution is the measurement of the density and duration of smoke emission. This article details some of the methods used and discusses their effectiveness

Measurement of Smoke Density and Soot Fall*

By W. A. CARTER
Technical Engineer of Power Plants
Detroit Edison Company

THE MEASUREMENT of air pollution requires the determination of the quantity of two different classes of solid impurities in the air, those which are held in suspension, and those which, due to their greater density or shape, fall to the ground or the roofs of adjacent buildings. In tracing the causes of such air pollution it is customary to measure the concentration of solid particles in the emission of gases from smokestacks and other sources of gaseous discharge.

The solids held in suspension in the air consist of a number of different materials, and while smoke and fly ash may be in the majority in certain localities, particles of soil, rock, brick, rubber from automobile tires, and various organic materials are generally also present. The proportions of these materials suspended vary according to the size and nature of the industrial activities of the community. While clouds of these impurities may vary in color, all of them filter out some of the ultra-violet rays from the sunlight, the amount so filtered depending on the concentration of such impurities in the atmosphere.

In measuring the solid emission from smokestacks the usual method is by color shade comparison. Accurate estimation of the density of such smoke (including any accompanying fly ash) by such comparison is of decidedly questionable accuracy, due to several uncontrollable factors. These factors include the difference in color effects of different thicknesses of smoke, the direction of the wind with respect to the observer, the effect of reflected light as well as of transmitted light, the presence or absence of direct sunlight, and the difference in the effect of black particles as compared with the lighter-colored ones, such as pulverized-coal fly ash. If smoke from metallurgical processes is excluded, the case is somewhat simplified, since this eliminates the majority of the red, brown and certain of the white particles, and confines the comparison to the blacks and grays of the stack discharge.

A method in common use compares the stack emission with standard charts, such as the Ringelmann smoke chart. This consists of five grades of black, varying from solid white to solid black, each color on the chart being a 20 per cent increase in color graduation. In use the chart is mounted about 50 ft. from the observer and directly in line with the top of the stack. The density of the smoke is then estimated by comparison with the color graduations of the chart. The observations are made at regular intervals, and for accurate work four observations per minute are generally made. Such observations of emission may be made for any given moment,

*A recent paper presented before the Smoke Prevention Association at Grand Rapids, Mich.

or averages may be struck by continuing the observations over any length of time desired. Such averages are sometimes stated as the equivalent number of minutes of No. 1 smoke (the first 20 per cent of color density) for the observed period.

In making observations the density of the smoke is taken directly across the top of the stack. The best point from which to make observations is where the wind is blowing the smoke in a direction at right angles to the observer. The worst point is where the smoke is being blown directly toward the observer. Observations looking away from the sun are more reliable than those taken in the other direction. The character of the sky and the general condition of the weather must be taken into account when making observations.

Other forms of this graduated color chart have been developed, some using finer and more accurate graduations in color, while others attempt to give color comparisons while the chart is held in the observer's hand. An instrument known as the Umbrascope, frequently used for observation of stack emissions, consists of a short tube somewhat like a telescope and a number of hinged and clouded glasses, all of the same color, which are swung into the tube one by one, and fill only half of the field of vision. The smoke is observed through the clear half of the field of vision, and a comparison is made by dropping the glasses in one by one, the number of glasses required to balance the color of the smoke being a measure of its density.

The Bausch & Lomb smoke inspection instrument consists of a telescope mounted on a tripod for observation at long distance and from a high point. When sighting through the instrument two circular gray screens, conforming to the limiting density permissible, are mounted within the instrument and appear in the field of vision. A comparison is made by training and focusing the instrument so as to bring the stack emission between these two screens, the comparison then being made. This instrument, due to the distance of clear vision possible, allows the accurate location and observation of a number of stacks from one fixed point. A disadvantage results from the screening effect of a smoky atmosphere between the observer and the stack under inspection.

The usual methods of measuring the density of suspended impurities in the general atmosphere consist of measuring the dust content of air samples drawn continuously or at intervals. In the Owens jet dust counter a sample of the air under observation is moistened by remaining for a few moments in a tube lined with wet blotting paper. A definite volume of this air is then drawn through a small orifice by a suction pump. The air, expanding through the orifice cools, and the moisture condenses on any dust particles present. These moist particles impinge on the surface of a microscope slide and stick to the glass. The slide is then removed and the particles counted under a microscope, and the results reported in number of particles per cubic foot of air.

Figs. 2, 3, and 4 show photomicrographs of air samples collected in this way, Fig. 4 being a slide of a sample of London smoke fog magnified to 200 diameters,

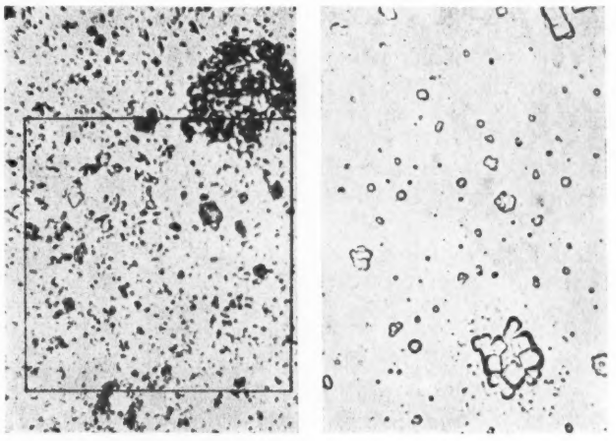
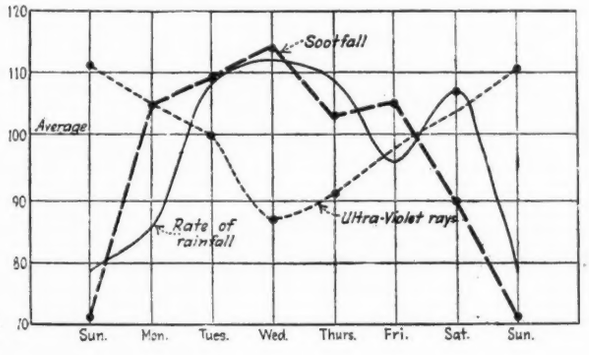


Fig. 2 (Left) Dust particles from a Mine Ventilating shaft. 650 diameters

Fig. 3 (Rright)—Salt particles from a haze occurring in hot dry weather. 650 diameters

the slide being laid out in micrometer squares for counting. Fig. 2 shows the particles drawn from a sample of air from the ventilating shaft of a mine and magnified to 650 diameters. Fig. 3 shows a sample drawn from a haze composed of crystals of common salt during hot dry weather and magnified to 650 diameters. The reliability of such samples as a measure of average air pollution depends on the extent to which the air sample, consisting of only a few cubic inches, represents the average atmosphere.

The automatic filter makes an hourly record of the suspended impurities in the air. In this instrument a water aspirator draws a continuous stream of air at a standard rate through a spot on a disk of special filter paper, which thoroughly removes the suspended impurities. The dirtier the air the darker the stain left on the paper. Periodically the filter paper disk revolves a slight amount, so that during



— ot fall affects ultra-violet radiation

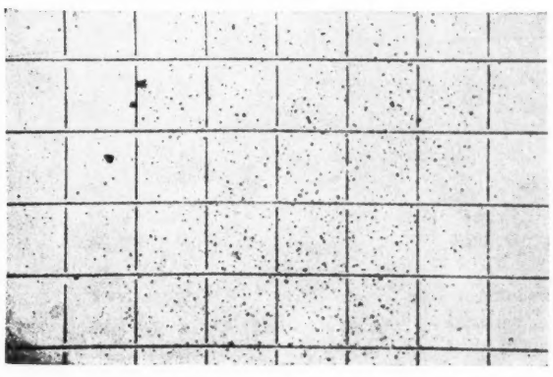


Fig. 4 — London smoke fog. 200 diameters

twenty-four hours there is a series of dark stains made.

This instrument measures the degree of dirtiness which appears to the eye as varying shades of grayness on the filter. The estimation of the degree of coloration by comparison with a standard scale of ten shades is not in itself a direct measure of the suspended impurity of the air. To convert the shade number for the stain into the weight of suspended impurity per unit volume of air requires the development of conversion factors by scientific experiment, and this degree of coloration varies with the nature of the impurity. The essential feature of this instrument is that it shows the variation in the state of suspended impurities in the air during the twenty-four hours.

The measurement of ultra-violet radiation is also used in studying the amount of suspended impurities in the air. The more impurities, the less ultra-violet radiation that will be received at the earth's surface. A daily test to estimate the integral action of ultra-violet rays as received at the surface can be made with a small quartz tube filled with a solution of methylene blue in acetone, and so located that radiation from the whole extent of the sky may fall directly upon it. At the end of twenty-four hours the fading of the blue color, due to ultra-violet rays, is determined by comparing the color of the solution in the tube with a standard set of shades numbered 1 to 10. Due allowance must be made for the number of hours of daylight and for the altitude of the sun when comparing results from different localities. Fig. 5 shows a typical weekly graph by days of ultra-violet radiation. Sootfall and rainfall are also plotted to show their interrelation.

A number of devices are available for observing and measuring the density of solid material in the flue gas as it passes through the boiler breeching or up the stack.

A simple device used to indicate to the fireman the clearness of the flue gas consists of a motor-driven blower which draws a small continuous sample of gas from the flue and discharges it in front of a frosted electric light bulb at a point where he can readily see it. Another device for the observation of smoke consists of a plain or convex mirror mounted at a suitable angle outside the boiler house so that the smoke emitted from one or a group of stacks may be watched.

A more elaborate device, Fig. 8, consists of a light and a reflector for the projection of this light across the breeching. A series of 90-deg. reflecting mirrors, the first one located on the side of the breeching opposite to the source of light, bring the reflection down to a ground glass screen where the dimming of the light by the obstruction of the smoke may be handily observed.

In the Eddy smoke recorder a steam aspirator draws a continuous sample of flue gas, this stream of gas being discharged by a motor-driven pump through a nozzle against a white clock-driven chart. The variation in color of the stain on the chart shows the time and duration of smoke emission, smoke densities being directly comparable with those obtained by the Ringelmann chart method. The readings are not influenced by the diameter of the stack, as with the Ringelmann chart, but there may be some question regarding the representativeness of the sample.

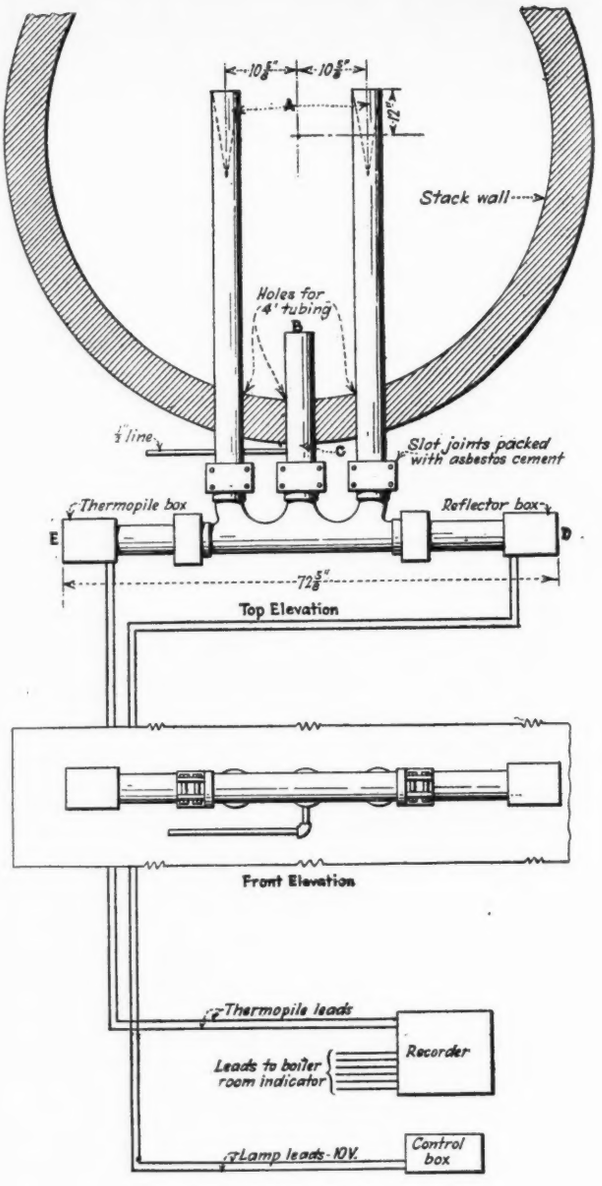


Fig. 6—Thermopile Smoke Recorder

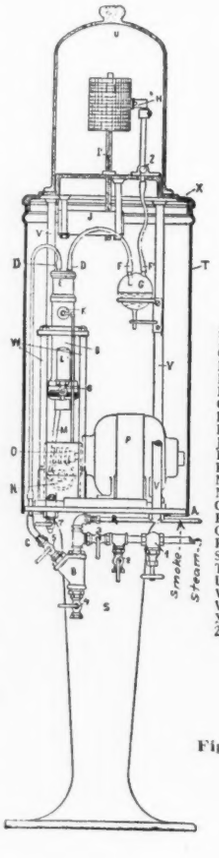


Fig. 7—Eddy Smoke Recorder

The Westinghouse smoke recorder operates on a somewhat different principle, a beam of light being projected across the stack or breeching onto a photo-electric cell on the opposite side. The amount of this light beam received by the photo-electric cell varies with the density of solid particles in the passing gas. The current flowing through the cell is thus varied, and is amplified so as to be sufficiently large to operate standard instruments. These are calibrated in degrees of smoke density as read on the Ringelmann chart. The principal part of this instru-

ment is the photo-electric cell, a device which translates light impulses into electrical impulses, the amount of current flowing being directly proportional to the amount of light falling on the cell.

The light-source unit, consisting, essentially, of a low-wattage incandescent lamp, a condensing lens for collecting the light rays into a parallel beam, together with the photo-electric amplifier and control unit, are on opposite sides of the stack or breaching. The indicating and recording instruments may be located at any convenient place within reasonable distance. Unless the lens of the instrument is kept clean, the readings will be too high. The voltage variation of the supply circuit must be kept within reasonable limits to avoid errors. The accuracy of the instrument is not affected by the color of the suspended particles.

The Leeds & Northrup smoke recorder and alarm differs from the Westinghouse instrument in that the ray of light focused through the sample tube impinges upon a thermopile instead of a photo-electric cell. It also differs in the arrangement of the tube through which the beam of light shines. The thermopile is a series of thermocouples generating varying electrical potentials, depending upon the amount of light units shining upon them. The denser the smoke the less light shining and the lower the voltage developed by the thermopile. This instrument is independent of voltage variation of the supply circuit, and its accuracy should not be affected by the color of the flue dust.

The deposit gage, shown in Fig. 1, seems to be the most reliable device for collecting samples of impurities that have fallen from the air. When collected for identification and measurement they divide themselves into those that are soluble and those that are insoluble in water. The quantity of such particles is unsually reported as total solids per unit of land area per unit of time. The deposit gage shown consists primarily of a galvanized iron funnel 27 in. in diameter at the top

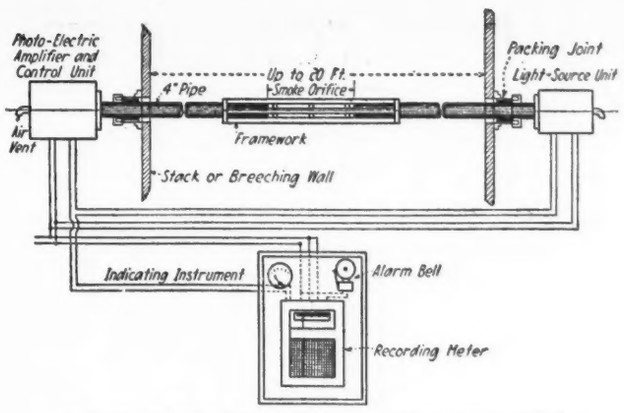


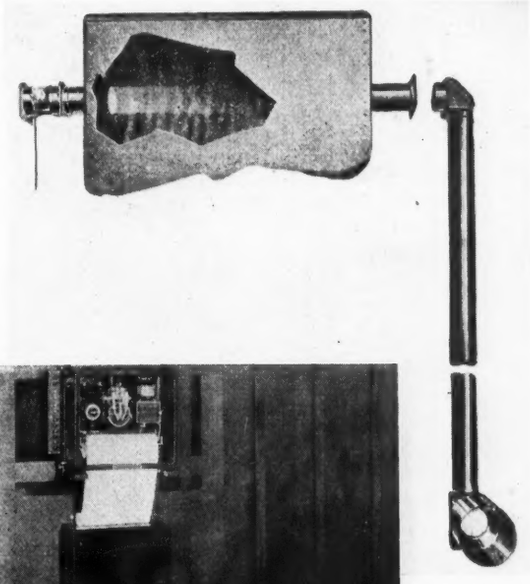
Fig. 10—Westinghouse photo-electric smoke recorder

the inside surface being varnished to allow the particles to slide down readily into the 5-gal. bottle below, which is partly filled with water. A tight connection must be maintained between the nozzle of the funnel and the bottle. The screen extension to the cone is installed to prevent birds perching on the edge of the cone. During freezing weather alcohol should be added to the water in the bottle to prevent freezing.

Periodically the cone is washed down with pure water and the bottle taken to the laboratory for analysis. In the laboratory the contents of the bottle are measured, and the results reported as tons of deposit per square mile per month. These solids are further analyzed to determine the percentage of water-insoluble particles, which are divided into tar, carbonaceous matter other than tar, and ash, the soluble matter being divided into ash and volatile, which is further divided into sulphate, chlorine and ammonia.

These instruments all have as their first object the determination of air pollution by solid impurities and the measurement of such emission of impurity from smokestacks and gaseous discharges. The information thus obtained is valuable in controlling the extent of air pollution. This is the primary duty of the smoke inspector.

Every opportunity should be taken to advise achitects designing industrial power plants, the contractors erecting them and the operators as well, on the means of reducing the smoke and flue dust emitted from the stacks of such plants.



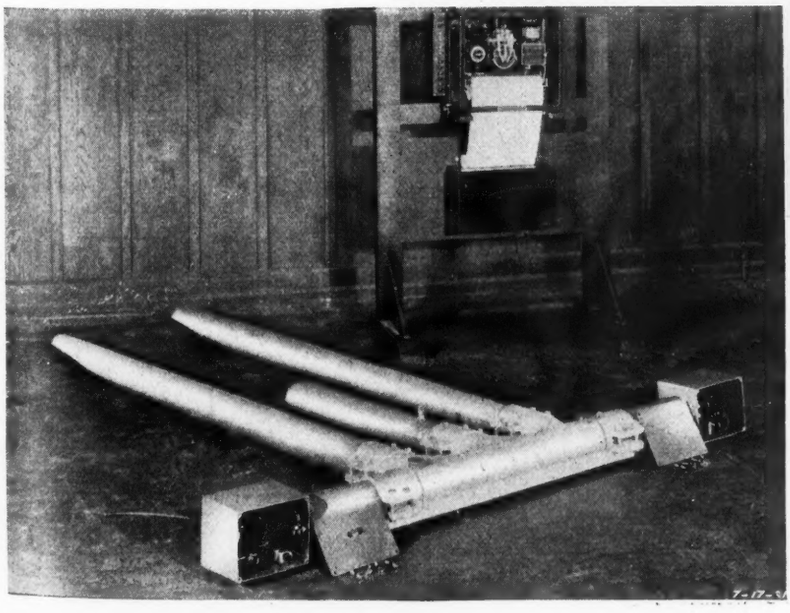


Fig. 8 (Above)—Eclipse Smoke Indicator

Fig. 9 (Left)—Leeds & Northrup thermopile smoke recorder

READERS' COMMENTS

Increasing Boiler Capacity

IN THE Oct. 20 number of *Power* L.G.M. asked "How can the capacity of our steam-generating plant be increased to meet additional load without installing new boilers?"

It will be interesting to me to know exactly what he meant in his question. My assumption would be that adding an economizer, a superheater or a steam accumulator, would be equivalent to installing a new boiler, and that, evidently, is what the questioner does not want to do. Surely the use of such equipment would be equivalent to building an extension onto the boiler to add surface.

I think the answer by H. M. Spring is good, with the exception of his suggestion that an economizer might be installed. The steam accumulator suggested by Alfred W. Fox, it seems to me, would cost as much or more than a new boiler and would require more space. Wallace H. Martin also recommends a steam accumulator, while Theodore Maynz recommends an economizer, as does Elmer N. Anderson. A feed-water heater utilizing exhaust steam for heat would fall within the specifications so far as additional heating surface is concerned, but in the last analysis a feed-water heater does not make a boiler more efficient. It is true, of course, that a feed-water heater does increase the over-all efficiency of a given boiler plant.

So, if I were L.G.M. I believe I should throw out most of these suggestions because they do not comply with the desired conditions.

Knowing that boilers can almost invariably be increased to higher capacity by improving baffling and furnace conditions, my suggestion is to move the bridge wall back, provided there is a bridge wall, and increase the radiant-heat-absorbing area. Also I should move the first-pass baffle back, sloping it properly so that the gas velocity would be reduced and yet be correctly constant throughout its entire travel. The first pass would then generate much more steam than it now generates and the chances are that the temperature of the flue gas would be no more after the improvement than it is now. Perhaps it will be necessary to enlarge the furnace, for much depends upon the size of the present furnace.

If the boilers are of the bent tube type I recommend practically the same thing.

Newark, N. J. W. F. SCHAPHORST.

Wanted—A Feed-Water Moses

IN THE Aug. 4 number there appeared an interesting editorial entitled "Wanted—A Feed-Water Moses." In the Sept. 29 number J. B. Swift offers a precise solution of the feed-water problem. All we have to do is to maintain 4 gr. per gallon of caustic alkalinity, 8 gr. per gallon of non-caustic alkalinity, and 5 concentrations in the boiler. The control is merely to run tests that "can be made in a few minutes by a man who need not even know what they mean." In an article in the Sept. 8 number, Mr. Swift elaborated on the same subject, but did not tell us how this unstable condition is corrected. Anyone familiar with the chemical reactions within a steam boiler realizes that non-caustic alkalinity or soda ash is unstable, especially in low concentrations. To maintain the prescribed conditions excessive soda-ash feed is necessary, or else the blowdown must be high. A 20 per cent blowdown, even when using heat exchangers, becomes an expensive proposition.

In all our experience with alkaline boiler waters we have found few waters which meet the conditions recommended. If these conditions are possible, and if Mr. Swift is able to tell us how he retards the normal chemical reactions, then he is certainly entitled to the rôle of a "Feed-Water Moses." FREDERICK G. STRAUBE,

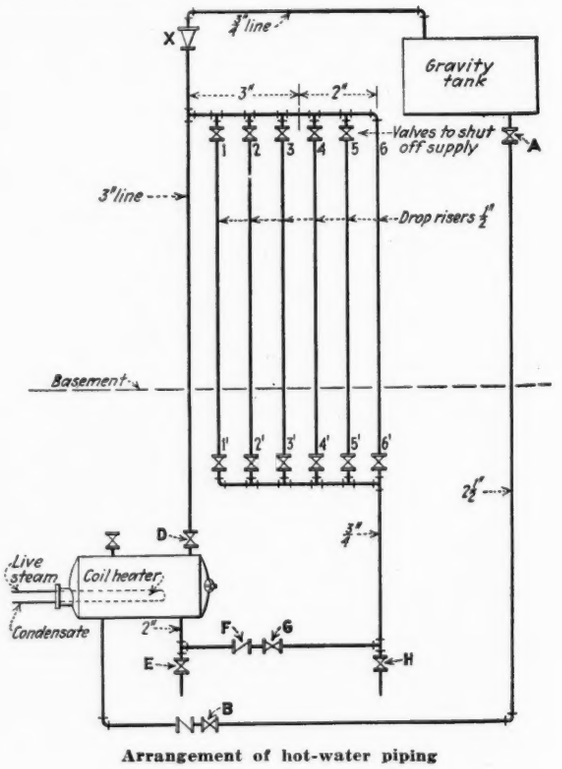
Urbana, Ill. University of Illinois.

How Faulty Water Circulation Was Improved

WITH REFERENCE to the article by L. W. Ross in the July 7 number, "How Faulty Water Circulation Was Improved," and the comments of V. J. Cucci in the Sept. 8 number, the accompanying illustration shows how similar trouble was corrected in one installation, making it possible to shut off any one or all lines, or to blow them separately or together.

The line controlled by valve *D* is reduced at *X* to ¾ in. and leads to a gravity tank, thereby taking care of expulsion of air, and also, in conjunction with the relief valve on the hot water generator, taking care of excess pressure. Valves 1 and 1′, 2 and 2′, etc., control supply and return of the respective drop risers. Turning off valve *G* and opening valve *H*, the drop risers can be blown down simultaneously; or with five of the risers turned off, each one can be blown down separately. By turning off valve *G* and opening valve *E* the hot water generator can be blown down, and by turning off valve *B* and valve *G* the riser to the hot water supply can be blown down in conjunction with the generator. This arrangement worked very satisfactorily. M. BUSILLO.

Philadelphia, Pa.



Arrangement of hot-water piping

Unequal Loading Decreases Elevator Rope Life*

Test results which show the difference that may exist in the loading of hoist ropes on traction elevators, and how the unequal tension causes premature failure of the ropes

By A. S. RAIRDEN
Chief Engineer
American Cable Company, Inc.

THE DIFFERENCE in life obtained from lengths of rope cut from the same reel and used as hoisting ropes on an elevator prompted an investigation to determine the reasons for the variation. Certain phenomena indicated unequal loading of the ropes to be a contributing cause. Subsequent investigations were carried out to prove or disprove this conclusion. Laboratory tests conducted to substantiate the findings in the field were not confined to one make of rope. Preliminary investigations consisted of measuring the loading of ropes on several elevator installations of which those given in Tables I and II are typical examples.

Although in actual practice the useful life of ropes is determined by visible outer deterioration, in the investigations referred to, both inner and outer deterioration was kept in mind as the gage by which a rope should be discarded.

The test consisted of running the ropes back and forth over three 20-in.-tread diameter U-grooved sheaves with a reverse bend in the rope over the bottom or middle-positioned sheave, as indicated by the inserts in Figs. 1 and 2. The sheaves in the machine are free to revolve on horizontal axes spaced 24 in. apart. The desired tension or load is applied to the rope subject to test. The test samples were all cut from the same length of rope possessing uniform characteristics throughout.

With the first appearance of visible broken wires the rope was removed and taken apart to determine the number of broken outer wires next to the core and invisible from the outside, within the test length of rope. In all these tests, and also in the field investigations, it was found that a wire rope is condemned long before the inside wires of the strand start to break. The reason for the inside wires not breaking is that they have a much larger radius of curvature as twisted in the strands than do the outer wires. The tests were repeated and subsequent ropes were run to gradually increasing degrees of final deterioration. The worst condition of impairment as evidenced by the number of broken visible wires was arrived at in equal increments. In every case when the desired point of deterioration was reached the test rope was removed and examined to determine the number of broken outer wires next to the core.

TABLE I — RESULTS OF LOADING TESTS MADE ON 1 TO 1 TRACTION ELEVATOR USING ⅝-IN. 6×19 TRACTION-STEEL HOIST ROPES, BUILDING *C*

Rope No.	Loads in Pounds Car at Bottom of Hoistway	Car at Center of Hoistway	Load in Pounds Car at Top of Hoistway
	Elevator A, No. of Floors, 4		
1	2,100		2,300
2	1,800		2,100
3	3,200		3,900
4	1,800		1,900
5	1,900		2,100
6	1,900		2,100
	Elevator B, No. of Floors, 4		
1	2,100		2,100
2	2,300		2,400
3	2,100		2,500
4	1,900		2,400
5	1,600		2,000
6	2,000		1,900
	Elevator C, No. of Floors, 7		
1	1,700	2,050	2,600
2	1,700	1,800	1,800
3	2,300	1,750	2,700
4	2,100	2,600	3,900
5	2,600	2,700	3,100
6	2,000	2,000	2,100

Tests Conducted on Wire Rope

These tests were conducted on pre-formed rope and non-pre-formed or ordinary rope of traction-steel grade in order to find out the action of both types. Pre-formed rope is a construction that has its strands preshaped to the spiral path that they naturally assume when twisted around the core. In this type of rope no torsional or untwisting forces exist and the rope will not fray or fly apart when cut without being seized.

The tests were carried out under two different conditions of tension. In one series of tests made loads were applied equal to 1/24 of the rated breaking strength of the rope. In other tests the load applied equaled 1/10 the breaking strength of the rope. The results from these two series of tests are shown in Figs. 1 and 2.

Curves *A* and *C* in Figs. 1 and 2 show the relation between outer, or visible, broken wires and invisible broken outer wires next to the core in a non-preformed rope. Curves *B* and *D* represent this same relation in a pre-formed rope. The number of broken wires next to the core in both types of ropes when a condition of deterioration existed equal to 20 broken wires per foot of rope visible on the outside is shown in Table III.

The life of the various ropes may be expressed in terms of per cent at the points of final deterioration (20 broken wires per foot) as in Table IV.

The length of rope life under light loadings is greatest. This is, of course, gaged by the visible deterioration of the ropes. In reality the ropes represented by Tables III and IV have been run to

*A paper, "Premature Failure of Elevator Ropes Due to Unequal Tensions," presented at the annual convention of the Elevator Manufacturers' Association of the United States, held in the Waldorf-Astoria Hotel, New York City, Oct. 27 to 29, 1931.

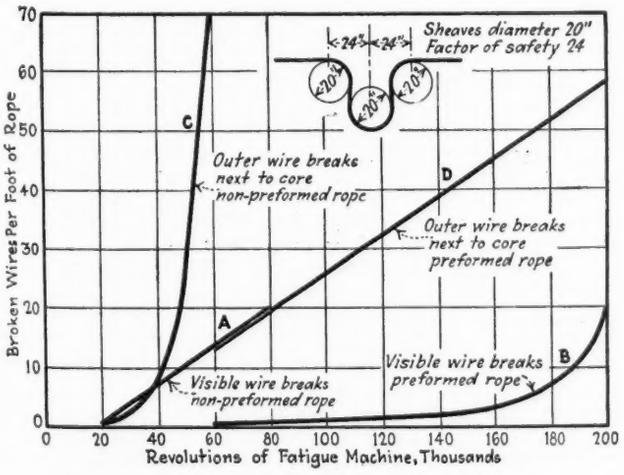


Fig. 1—Relation between visible and invisible broken wires in ropes loaded to a factor of safety of 24

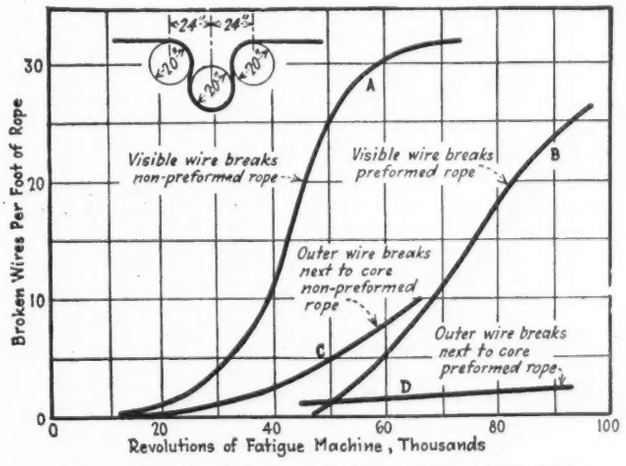


Fig. 2—Relation between visible and invisible broken wires in ropes loaded to a factor of safety of 10

TABLE II — RESULTS OF LOADING TESTS MADE ON 1-TO-1 TRACTION ELEVATORS USING ⅜-IN. 6×19 TRACTION-STEEL HOIST ROPES, BUILDING *E*

Rope No.	Car at Bottom of Hoisting	Car at Top of Hoisting
Elevator D, No. of Floors, 40		
1	2,300	2,700
2	2,000	2,700
3	2,300	2,000
4	1,600	3,400
5	2,300	2,100
6	800	1,600
Elevator E, No. of Floors, 40		
1	1,900	2,100
2	1,200	2,550
3	1,100	2,700
4	2,400	2,300
5	1,600	2,000
6	1,900	2,000

a point where a sacrifice in safety has occurred.

A factor of safety equal to 10 more nearly approaches actual conditions of wire-rope usage on elevators. With this loading the condition of the outside of the ropes indicates when they should be removed from service, because the rate of invisible deterioration progresses at a much lesser rate than the visible.

In the field investigations of unequal deterioration of hoist ropes used in parallel it has been found that unequal tension has been responsible for premature breakage of inside wires next to the core. These parallel ropes were cut from the same initial length, and it may be assumed that their physical characteristics were uniform.

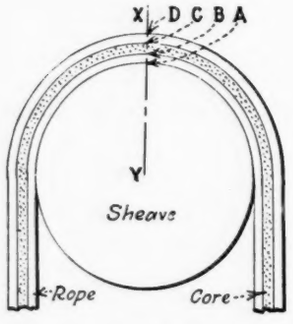


Fig. 3—Diagram of a wire rope bent around a sheave

Analysis of Test Results

Fatigue crown breaks of wires both on the outer exposed strand crowns and on the strand crowns bearing against the core of the rope are caused by the magnitude of the fiber stress in the wires due to bending, the ratio of this stress to the ultimate tensile stress of the wires, and the number of repeated bends the wires receive. The wires bent to the smallest radius of curvature develop the greatest bending fiber stress and will fail the quickest.

Considering cross-sectional plane *XY*, Fig. 3, through a wire rope bent around a sheave, the magnitude of the resultant fiber stress due to the radius of curvature of the wires will vary from the greatest to the smallest values in the order of *A, B, C, D*. It then may be expected that the wires, when subjected to the same number of bends, will fail in the order *A, B, C* and *D*. However, when the rope is subjected to a certain load the strands develop a compressive radial pressure on the hemp core. This radial tensional force increases with increased loads on the rope and also reacts opposite to the bending fiber stress developed in the wires. While the radial tensional force of the hemp is increased, it also reacts opposite to the bending fiber stress in the wires and tends to decrease the resultant magnitude of this stress. This action, therefore, increases the ratio between the bending fiber stress and the ultimate fiber stress of the wires and in turn increases the life of the wire under repeated bending.

The conclusion is that the fatigue life of the outer wires of the strands next to the core is proportionately increased as compared to the fatigue life of the outer wires on the outer strand crowns with increased loads on the rope.

TABLE III — NUMBER OF BROKEN OUTER WIRES NEXT TO CORE PER FOOT OF ROPE

Factor of Safety	Non-Pre-formed Rope	Pre-formed Rope
24	153	58.4
10	3.7	2

TABLE IV — LIFE OF THE VARIOUS ROPES EXPRESSED AS A PER CENT OF A DETERIORATION OF 20 BROKEN WIRES PER FOOT

Factor of Safety	Non-Pre-formed Rope Per Cent	Pre-formed Rope Per Cent
24	40	100
10	23	41

▼ ▼ ▼

Equalizing the Load on Elevator Ropes*

By W. P. FROST
President
The Evans Elevator Equalizer Company

OF THE many factors affecting traction-elevator hoisting-rope life none is of greater importance than load distribution. Load distribution between the hoisting ropes is influenced in several ways that have a direct relation to their life, the safe operation of the equipment and its power consumption.

To indicate how serious unequal stretch may be, attention is called to where one of a group of six hoisting ropes stretched several inches more than the others in about three weeks. This trouble occurred with the hoist ropes on a U-grooved full-wrap traction machine in a 32-story building. If it were not that automatic means were provided to equalize the loading on these ropes, the excessive stretch in one rope would not have been discovered when it developed, and might have been overlooked entirely.

Unequal stretching of the hoist ropes is more prevalent than is generally realized. In several instances an inspection of automatic equalizers on new cars has shown the ropes to be so different in length that one or more of the equalizing bars were turned as far as it was possible for them to go from the normal horizontal position. For the bars to do this requires a difference in rope length of about 16 inches.

The ropes on these cars were put on by the elevator manufacturers' mechanics, so that it is fair to assume that they were properly installed and equalized before the elevators were started. Nevertheless in a few weeks their difference in stretch was such as to turn the equalizing bars to their extreme positions. If it had not been for the automatic equalizers three or four of the ropes would have been carrying practically all the load, and probably this condition would not have been discovered, if at all, until the elevators had been in service for a long time. If the ropes are operated for several months with extreme differences of loading, as the foregoing experiences show to be possible, their useful life is seriously impaired.

Provisions must be made to compensate for unequal stretch if the ropes are to be kept equally loaded and a maximum of use obtained from them.

The sheaves over which the ropes run are probably the most troublesome element in maintaining equal tension in the ropes. Unless all the ropes have identically the same diameter and the sheave grooves are the same size and all grooves have the same tread diameter, the ropes will have a tendency to travel at different speeds. If the ends of the ropes are fixed at the car and counterweight crossheads, some of them must slip in the sheave grooves to compensate for the tendency to travel at different rates. This slipping wears the grooves and the ropes unequally and further aggravates the already objectionable conditions. It also causes loss of traction between the ropes on the sheaves, interfering with accurate landing of the cars and increases power consumption.

If the tread diameter of one groove is 32 in. and that of another is 31 $\frac{13}{16}$ in., on a traction sheave, the difference in rope travel is 11 in. in 500 ft., and must be compensated for by the ropes slipping in the grooves. This difference in rope travel is caused by one groove being only $\frac{3}{32}$ in. deeper than the other, which is not an excessive condition for a worn sheave.

Even when the ropes and sheaves are

*Abstract of a paper presented at the annual convention of the Elevator Manufacturers' Association of the United States, held in the Waldorf Astoria Hotel, New York City, Oct. 27 to 29.

new there is a difference of travel between the ropes. When automatic equalizers are part of the original elevator installation a small movement of the equalizer bars takes place as the car moves up or down the hoistway, thus showing a differential of travel between the ropes. This is no fault of the rope or elevator manufacturer, but is the result of small imperfections beyond the control of either. When they are compensated for, these slight variations in the ropes and sheave remain fairly constant and do not become worse rapidly as they do when the rope must slip in the grooves to make adjustments for their difference in ratio of travel.

Rope-Loading Tests

The tendency of the ropes to travel at different rates, due to dissimilarities in them and in the sheave grooves in which they run, produces unequal loading of the ropes. Loading tests made on the hoist ropes of traction machines have shown that this difference of loading may be as much as 5 to 1. When the load on the lightest loaded rope was less than one thousand pounds that of the heaviest loaded rope was several thousand pounds. These tests also showed that there may be a wide variation in the loading of the rope when the car is at the top and at the bottom of the hoistway.

There is every reason to believe that these tests were made on elevators that represented normal conditions, where the sheave grooves offered a minimum of resistance to the ropes slipping to compensate for unequal loading. Under abnormal conditions, where the ropes have a tendency to wedge into the grooves, there are possibilities for one or two of them carrying practically all the load. Where such conditions exist it is easy to account for the short life of some ropes. One rope in a set has been known to fail unexpectedly and for no apparent reason. Fatigue of the metal in the rope due to overloading was undoubtedly the cause of the failure. This rope happened to be taking a large part of the total load, and it did so until fatigue of the metal caused it to fail.

Laboratory tests have shown that bending a lightly loaded rope over a sheave causes the outside wires in the strands to break near the core, where they are not visible. Consequently, if one rope, due to excessive stretch, has operated under a light load for a long time, it may be in a dangerous condition without giving external evidence.

Loading Due to Bending

Loading of the ropes is usually considered as the vertical pull of the car and counterweight on them. The greatest stresses, however, occur in the ropes where they bend over the sheaves. Under normal working conditions a rope tends to compensate for these bending stresses. If a rope is overloaded it cannot readily be adjusted for the bending action and the loading in the bend may be far in excess of that caused by the weight of the car and counterweight. These bending stresses may account for some of the unexpected rope failure previously mentioned.

Such conditions carry with them a serious hazard to life and property. Almost anything may happen when several hundred feet of wire rope come down a hoistway. Because a serious accident may not have occurred is no reason why it will not, and the possibility should be guarded against. When automatic equalizing of the ropes is provided, unequal loading is prevented and excessive variation in the ropes' working conditions are readily detected and can be corrected before they are damaged.

When the ropes connect to fixed shackles at the car and counterweight crossheads, equal tension in them is a matter of a mechanic's judgment, when they are installed and throughout their life. Pulling the ropes sideways across the hoistway to check their loading is at best a rough approximation. Even when a scale is used for this purpose there are opportunities for considerable error in the loading of the different ropes. When automatic equalizing is provided errors in loading the ropes are immediately apparent and can be readily corrected. When the car is put into service, if abnormal differential of travel exists between the ropes it is easily detected by the excessive movement of the equalizer. Knowing that the fault is present, proper means can be taken to correct it.

RECORD OF ROPE LIFE ON HIGH-RISE CARS IN EQUITABLE LIFE ASSURANCE SOCIETY'S BUILDING, NEW YORK CITY*

Car. No.	Mileage Without Equalizer	Date Removed	Mileage with Equalizer up to Sept. 28, 1931	Per Cent Mileage Increase
2	21,066	Feb. 22-27	31,286	48.5
3	17,765	May 14-27	31,484	77.2
5	20,437	Sept. 19-27	27,295	33.5
6	11,614	Sept. 12-26	29,416†	153.8
7	13,138	Feb. 28-27	26,484	100.01
9	15,301	Jan. 8-27	34,752	127.1
10	20,452	Oct. 2-27	29,222	42.8
17	12,267	Mar. 12-27	20,622	68.1
13	16,666	Sept. 13-27	27,558	65.3

*Equalizers are installed on 25 cars, but on 16 of the cars they have not been in service long enough to give significant rope-mileage records.
†These ropes were replaced on Jan. 24, 1931.

Automatic equalizers on the ropes allow the building engineer to make an inspection of their loading without even stepping on top of the car. This is done by calling the car to a floor about halfway up the hoistway and having the operator drop it down to a position where the equalizer can be seen from the landing. The position of the equalizer bars tells the story. If they are turned to an abnormal position from the horizontal it is evidence that the ropes are not equal in length or that the travel differential between them is excessive, and proper measures can be taken to have the fault corrected.

It is not the intention to blame all the causes of short life of elevator ropes on those factors that produce unequal loading. However, some of the results obtained with ropes installed without automatic equalizers and others equipped with them show that unequal loading is apparently of far greater importance than is generally appreciated.

The figures given in the table were obtained under as nearly constant conditions as may be expected. The first set of ropes was installed by the elevator manufacturer's mechanics and was connected to the car and counterweight with fixed shackles. The maximum rope life on the nine elevators was 21,066 car-miles and the minimum 11,614, the latter being about one-half the maximum. When the second set of ropes was installed automatic equalizers were put in the car crossheads. All these ropes were in operation on Sept. 28 of this year with the exception of those on No. 6, which were replaced after giving a service of 29,416 car-miles, against 11,614 with the first set. This is an increased use of 153.8 per cent. The per cent change in life for the other ropes may be expected to increase considerably before they have to be replaced.

Long Rope Life

To date none of these sets of ropes has what would be considered long mileage, and their service life may not be known for quite a long period. The longest record of rope life, where automatic equalizers are used, was 77,000 miles when the last report was received on these ropes. At that time they were still in service. There are records of two other sets, one of which had gone 72,000 miles and the other 71,000 miles when the last report was received on them.

It would probably be difficult to prove just how effective automatic equalizers are in preventing false stops and reducing power consumption. The latter factor is another that has not been studied as carefully as it should be. In one large building, where studies have been made of power consumption before and after installing automatic equalizers on the hoisting ropes, the building operators report a reduction of 0.8 kw.-hr. per car-mile.

Equalizing Compensating Ropes

Although automatic equalizers were originally developed for use on the hoisting ropes, they are now available for installation on the compensating ropes. The first of these equalizers installed was tried as an experiment on an elevator where trouble was being experienced with the compensating ropes. The compensating sheave was unsteady and noisy in its operation. Conditions got so bad that one of the ropes came out of its groove and was broken, making it necessary to shut down the elevator for the immediate installation of a new set of ropes. The unsatisfactory operation continued, however, until an automatic equalizer was installed. This corrected the faulty operation and the ropes are still in service.

The location of the compensating ropes makes it difficult to observe their performance and to inspect them properly. For this reason they are not likely to get the attention that may be given the hoisting ropes. Neither is it as easy to adjust the loading on them as on the hoisting ropes. These factors probably account for the wide variations in the life of these ropes on different cars.

READERS' PROBLEMS

Conducted by

L. H. MORRISON

ICE MELTING RATE—*Is it a fact that the rate at which ice melts is influenced by the humidity of the surrounding air?* G.M.

Tests at the University of Tennessee reveal that from the 17½ per cent humidity point the melting rate increased rapidly with the increase of humidity. Also that the melting rate from 75 to 100 per cent relative humidity is much faster than from 25 to 50 per cent. This would not be the case if heat content from dry air to saturated follows a straight line curve when plotted against equal increments of humidity.

Heat-transfer rate is dependent upon what might be called a wetted surface, or upon the condensation of moisture. When warm air is passed over a cold surface, in this case ice at 30 per cent F. temperature, the heat-transfer rate increases with the humidity after the dewpoint of the mixture has been passed in the area surrounding the ice surface. The air, being warm and saturated, is passed over the ice, and because the ice is at a lower temperature the area immediately next to the ice is chilled. If it is chilled to a temperature below saturation it produces a condensation of the excess moisture. This gives a constant watered film over the ice which is being constantly removed. The rate at which this water is removed, or the depth of film, is dependent on the percentage of humidity and the air velocity.

DIATOMACEOUS EARTH—*From what is diatomaceous earth insulation made?* C.F.P.

Diatomaceous earth, also known as infusorial earth, is the term applied to the cellular skeleton of microscopic diatoms of past ages and consists of almost pure silica. The volume of the cell is 85 per cent void, which makes it an effective insulator, especially since it will stand high temperatures.

HORSEPOWER WINDMILLS—*Is it possible to drive a 10-kw. generator by a windmill? What power can be obtained from a 20-ft. mill?* E.E.

The theoretical horsepower of a windmill may be calculated from the formula

$$\text{Hp.} = 0.000005247\ D^2\ W^3$$

Where D = Wheel diameter in ft.

W = Wind velocity, miles per hour.

A 20-ft. wheel in a 15 mile breeze should develop 7.08 hp., but the mechanical efficiency is not over 15 per cent, which reduces the effective horsepower to about one.

DEWAXING LUBRICATING OILS—*Is there any advantage in so-called dewaxed lubricating oils, and how is the wax removed?* P.R.M.

Paraffin-base oils that have had all the wax which they originally contained entirely removed are highly desirable for use in modern engines, especially airplane motors. This wax is simply solid paraffin and it is quite solid at ordinary temperatures, but very fluid and non-viscous when heated slightly. The lubricating oils which contain only a small percentage of wax are solid at temperatures below 60 deg. F., and the wax must be entirely removed before the oil will flow at 0 deg. F. At higher temperatures, such as are encountered in an automobile engine, the same wax becomes like water and has no lubricating value.

The first method introduced was "cold settling." This may be briefly described as follows: The oil to be dewaxed is blended with naphtha and charged into a large insulated steel tank containing brine coils. As brine is circulated through the coils the temperature of the solution is gradually reduced. The wax begins to precipitate as crystals, which sink to the bottom of the tank. The amount of wax that is precipitated is proportionate to the number of days the oil is held at the cold temperature. Then the solution is drawn off from above, leaving the wax in the bottom of the tank. The naptha is then distilled from the solution, which leaves a lubricating oil containing a smaller percentage of wax than it did before cold settling. Lubricating stocks made by this method do not have a cold test of less than 40 to 45 deg. F. The finest oils are not processed this way, simply because the smaller wax crystals have a specific gravity so near that of the solution that they will not settle.

Modern refineries dewax by the use of centrifuges or by filter presses, and obtain oils that have cold tests ranging from 25 deg. F., the cold test depending upon the temperature to which the oil is chilled during processing and upon the skill of the operators. Various methods and equipment are used for chilling the oil to be dewaxed.

A Question for Our Readers

THE GRILL ROOM of our hotel is located in the basement, and even in winter there are complaints about the warm atmosphere.

Two suggestions have been made. One is to install unit coolers along the side walls and cool with brine from our refrigerating plant, which could not carry the load save by the addition of new equipment.

The second suggestion is that we install a system of air ducts and cool this air by the spraying of water previously chilled in a cooling chamber filled with ice and provided with coils through which the water would circulate. We can buy broken and discolored ice for $3 a ton. What do "Power's" readers think? E.M.J.

Suitable answers, if received promptly, will be paid for when published

DIFFERENCE IN GOVERNORS—*What is the difference between the flyball governor and the flywheel governor upon steam pressure, cutoff and piston speed?* J.T.S.

This question is impossible of answering, since it is not complete. A flyball governor may be employed to regulate engine speed either by altering the cutoff, as on corliss engines, or by reducing the pressure of the steam entering the cylinders, as with the D-slide-valve engine with a fixed eccentric. The flywheel governor is arranged exclusively to alter the valve cutoff. Both types act after the engine has experienced a speed change, and as the engine load increases the engine speed drops slightly, to cause a governor movement. A few flywheel governors are arranged to cause the engine to increase speed at an increase in the load.

SETTING OF BACK-PRESSURE VALVE—*What objection would there be to the setting of the atmospheric relief valve of an engine at 6 lb. when the reducing valve leading to process lines was set at 8 pounds?* R.J.

Setting the atmospheric relief at 6 lb. limits the pressure in the engine exhaust lines to 6 lb. Since the reducing valve regulates the flow to the process lines so that the pressure on the low, or outlet, side will be held to 8 lb. in event the pressure on the high, or inlet, side is above this, the reducing valve will open wide when the high side has only 6 lb. pressure. Due to the slight pressure drop through the valve slightly less than 6 lb. will exist in the process line. If 8 lb. pressure is needed in the process lines the engine atmospheric relief must be set for at least 8 lb. There is, in fact, no reason for the installation of the reducing valve.

On the other hand, if the reducing

valve is connected to a high-pressure line to supply 8-lb. steam when the engine exhaust is not sufficient, a different story is to be told. The pressure in the process line cannot go above 6 lb., due to the setting of the relief valve. Consequently the reducing valve attempts to raise the process pressure to 8 lb. and opens wide, with the result that live steam, reduced to 8 lb., flows out through the connection to the atmospheric relief line and is wasted.

—❖—

FLOW OF WATER IN PIPE—*A 12-in. pipe 2,000 ft. long discharges water under a head of 250 ft. What is the approximate discharge?* A.B.

The well known Chezy formula for flow of water in pipe may be used to solve this problem. The formula is $V = C\sqrt{RS}$, where

V = Mean velocity, ft. per sec. = $\frac{\text{discharge, cu.ft. per sec.}}{\text{area of pipe, sq.ft.}}$ or $\frac{Q}{A}$

C = Coefficient of pipe friction, which for an approximate solution may be taken as 100.

R = Hydraulic radius = $\frac{\text{pipe cross-section}}{\text{perimeter}} = \frac{d}{4}$

S = Loss of head in ft. per foot of pipe length.

Substituting the known values we have

$$V = 100\sqrt{\frac{d}{4}\,S} \text{ or}$$

$$\frac{Q}{A} = 100\sqrt{\frac{1}{4} \times \frac{250}{2{,}000}} =$$

$$\frac{Q}{0.7854\ d^2} = 100\sqrt{\frac{1}{32}}$$

$$\frac{Q}{0.7854} = \frac{100}{5.657}$$

Q = 13.8 cu.ft. per second or 6,210 g.p.m.

—❖—

CHECKING CHIMNEY SMOKE—*What is the Ringlemann chart which our local smoke ordinances refer to in respect to the permissible smoke emitted from a chimney?* S.G.

The Ringlemann chart is made up of four sections containing cross lines of different thicknesses. When placed at a distance of about 20 ft. the lines in each of the sections merge together, giving the effect of a solid background of different shadings, ranging from a faint gray to a black. A chart mounted on a stiff card may be procured from *Power* on request.

—❖—

OIL BURNER CARBONIZER—*What causes the tips of our mechanical oil burners to become covered with a carbon deposit, shaped somewhat like the crater of a volcano?* M.D.

The burner tip may be placed too far into the furnace, so that combustion starts immediately at the tip. A second probable cause is the overloading of the burner, which causes the spray to break and spread immediately upon issuing from the orifice, with the result that burning starts at the tip.

Operating Non-Return Valves

A Summation of Readers' Opinions On the Previous Question

IN OPERATING an automatic stop and check valve on a boiler we screw down the stem on the valve as a precautionary measure before sending a man in the drum, but leave open the valve next to the main header. After the cleaning is completed and the boiler is being prepared for firing, we raise the valve stem and allow the boiler to come on the line automatically. Is there anything wrong with this practice? G.R.J.

SINCE the leader of any cause abandons it when followers either fail to appear or swiftly fall away, the unanimity of the answers that the practice followed by G. R. J. is wrong indicates that he will speedily adopt a different procedure. The gist of the many answers that are incorporated in this review is as follows:

The A.S.M.E. boiler code, as well as the requirements of most states, calls for two stop valves between the header and the boiler. Obviously the two valves are intended as a safeguard to workmen entering the boiler. That one of these stop valves happens to be of the non-return type does not alter the case in any way. The pipe section between the two valves should be provided with a drain, and if the pipe is an inverted "U" or of any form whereby complete drainage is impossible with one drain, two such connections should be made, with the idea that any water left in the section by condensation might set up a dangerous water-hammer when the boiler is put on the line.

Not only should the non-return valve stem be run down to hold the disk tight, but the stop valve next to the header should be closed. If either valve leaks, the drain line, whose outlet should be exposed to view, will continue to blow steam. When the boiler is cold, the cessation of the drip indicates that the non-return valve has been at fault, while a leak at the stop valve will cause the drain valve to vent continuously. It is well at this point to mention that while the non-return valve stem should be run down, under no circumstances should a wrench or bar be placed on the wheel as an additional leverage, for extreme pressure on the stem may break the valve disk or distort the seat.

The procedure of taking a boiler off the line and employing it should be:

1. Close main stop valve.
2. Close non-return valve.
3. Open drain valve.
4. Open blow-off valve and drain boiler.
5. Close blow-off valve.
6. Open test cock on water column.
7. Remove manhole cover when test cock shows no pressure in boiler.

In addition to the closing of the stop and non-return valves, the feed and blow-off should be closed after the boiler is empty, and all valves marked with a warning tag.

The procedure to be followed in putting a boiler on the line varied somewhat with the different answerers. However, the majority advocated a method wherein as soon as the boiler has steamed up to approximate line pressure the fireman's helper opens the main stop valve. As soon as line pressure is reached by the boiler the fireman signals his helper to crack the non-return valve, which is done by giving the wheel about three turns. By this time the boiler pressure will be from 3 to 5 lb. above the line pressure. The valve disk should then rise of its own accord, which is indicated by the sudden drop of the boiler gage to the line pressure. However, a number of readers advocated screwing the non-return stem to the open position, opening the stop valve and permitting the boiler pressure to lift the non-return valve disk without more ado. But this second method, as several pointed out, does not take cognizance of the possibility of the disk sticking in the closed position, and suddenly opening after the boiler pressure has risen considerably above the header pressure, which might set up a severe water-hammer.

It is recommended to G. R. J. that he consult Section VI of the A.S.M.E. Code entitled "Suggested Rules for the Care of Power Boilers."

A point made by two or three readers is that when a boiler is being given a hydrostatic pressure test the stem of the non-return valve should be left in the open position, so that the pressure is taken by the stop valve; otherwise the non-return disk might be warped by the high pressure.

In the preparation of this discussion answers from the following readers have been used:

E. D. Beiser, Dayton, Ohio; H. J. Prebensen, Chicago, Ill.; W. H. Craighead, McKeesport, Pa.; E. P. Hoar, Bogota, N. J.; Raymond Septor, South Amboy, N. J.; A. J. Kugmann, Philadelphia, Pa.; P. Dias, Newark, N. J.; J. C. Porter, Saltville, Va.; W. H. Wellander, Wilmington, Calif.; Ira. R. Young, Braintree, Mass.; S. H. Rhodes, Howe's Cave, N. Y.; William C. Jones, Prova, Utah; J. C. Nutter, Quebec City, Canada; J. G. Carrier, Pittsburg, Calif.; and J. L. White, Lima, Ohio.

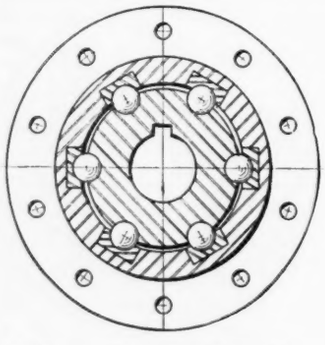
WHAT'S NEW IN PLANT EQUIPMENT

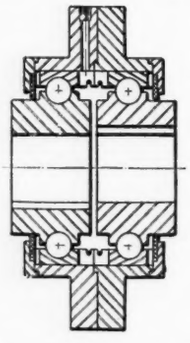
Flexible Coupling of Ball and Socket Design

IN THE flexible coupling (Davis) recently announced by the Penn Machine Company, Johnstown, Pa., the principle of the ball and socket motion is employed. Hardened and ground socket keys sliding in keyways cut in the outer rings fit over balls imbedded in the hub and permit the coupling to compensate for offset and angular misalignment.

The outer ring connects the two hubs through the socket keys sliding endwise in the ring and rocking over the imbedded balls in the hub. With this construction practically half of the area of the balls is always in contact in the socket keys. This provides maximum driving contact in all positions and at the same time provides free lateral float to the connected machines.

The coupling is made entirely of high carbon forged steel in a number of sizes and both shrouded and exposed types are available.

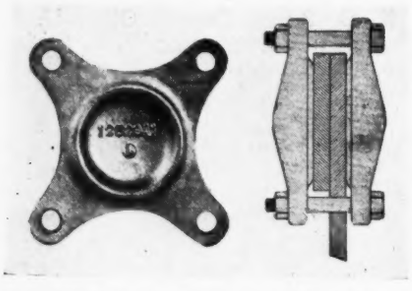




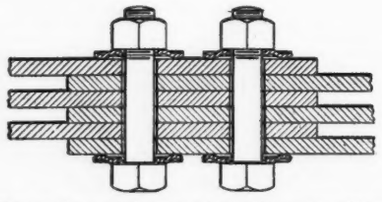
Cross section of Davis coupling showing arrangement of balls and sliding socket keys

Steel Clamp and Expansion Washer for Electrical Connections

TO MAINTAIN a constant contact pressure in buses and connections during varying current loads, the General Electric Company, Schenectady, N. Y., has brought out the steel clamp and expansion washers illustrated. The spring clamp, of non-magnetic steel, is for use on buses and similar connections where this convenient method of joining conductors can be used. The body of the clamp is shaped so that it will distribute the contact pressure independently of the spring action of the bolting lugs.



Spring clamp of non-magnetic steel



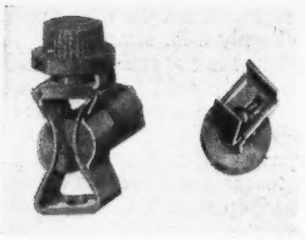
Expansion washers of bolted construction

The expansion washer for use on bolted connections is placed under the head and nut of the bolt. The washers measure 1½ in. in diameter and are proportioned to give full tension up to the elastic limit of a regular ½-in. steel bolt.

Garlock 701 brake lining

Industrial Brake Lining

AS A SUPPLEMENT to its line of packings, the Garlock Packing Company, Palmyra, N. Y., has introduced an industrial brake lining to be known as Garlock 701. The lining, which is designed for severe duty, is constructed of asbestos cloth, impregnated with a special rubber compound, then folded, molded, and vulcanized under 2,000-lb. pressure. It is available in widths from 1¼ to 12 in. and in thicknesses from 5/32 to 1 in.



Clamp prevents heating of fuse clips due to poor contact

Fuse Clip Clamps

TO PREVENT fuses from arcing and burning at contacts, the Ideal Commutator Dresser Company, Sycamore, Ill., has introduced the fuse clip clamp illustrated. The clamp is placed over the ends of the fuse contact and by turning a knurled knob the contacts are drawn tightly against the fuse, assuring a permanent contact. They are made in three sizes—30 amp., 250 volts; 30 amp., 600 volts; and 60 amp., 250 to 600 volts.

Protective Paint for Pipe Lines

ANNOUNCEMENT has just been made by the American District Steam Company, North Tonawanda, N. Y., of a protective paint for use on steam and hot water pipe lines.

The product has been named ADSCO Pipe-Kote 505. According to the manufacturer, it provides several important advantages over the ordinary paints in that it is impervious to any degree of heat generated by steam; is practically immune to the action of moisture, dilute acids and alkalis; and while it produces an extremely hard, tenacious coating, it is sufficiently elastic to expand and contract with the pipe without cracking or peeling.

While Pipe-Kote is especially recommended for use on steam and hot-water lines, it is said to work with equal effectiveness on gas and water mains, stacks, boiler fronts, bridges, and all other surfaces exposed to extreme or rapid changes of temperature and atmospheric conditions.

Photo-Electric Lighting Control Relay

TO ENABLE the intensity of natural light to control artificial lighting automatically, a new photo-electric lighting control relay has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. When the intensity of daylight increases to a certain point this device operates to turn on electric lights; and, conversely, when the natural light increases to a certain intensity it causes the lights to be turned off.

The operation of the lighting control relay is effected by variations in the intensity of light falling on a photo-electric tube. These variations produce proportional changes in the amount of current passing through the tube;

Lighting control relay with panel removed

and this changing current, amplified in a specially designed tube, energizes a primary relay controlling an auxiliary contactor, which, in turn, operates the main contactor controlling the lighting installation.

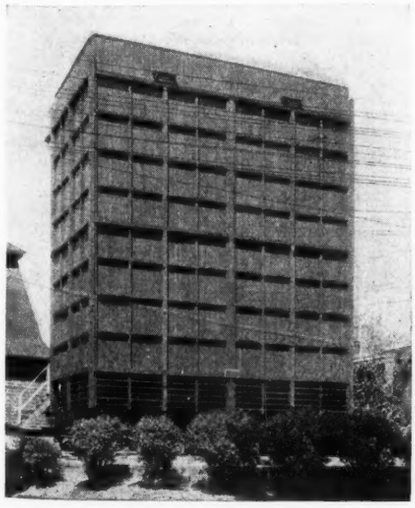
Two dials, mounted on a panel on the side of the box, are used for regulating the potentiometers, one controlling the intensity at which the device turns on lights, and the other the intensity at which it turns them off. The foot-candle range of these dials is varied by a three-position plug switch located between them.

Induced-Draft Water-Cooling Tower

IN THE new induced-draft water-cooling tower introduced by the Schubert-Christy Corporation, Affton, Mo., the fans are at the top of the tower, thus precluding the possibility of ice forming on the fan blades, as the fans handle the warm exhaust air only. By the elimination of fan houses the foundations are simplified and space requirements reduced. The design of the tower is such that the usual fan noises are effectively silenced and accident hazards are eliminated.

Multi-speed remote control of the fans permits adjustment to suit any load or weather condition. Large natural-draft openings make it possible to shut down the fans entirely for a large portion of the year.

The tower is constructed of cypress or redwood specially treated with a wood preservative. All metal parts are thoroughly rust-proofed or are made of a non-ferrous composition.



Water-cooling tower operates with induced draft

Non-Recording Type Pressure Control Instrument

A SIMPLIFIED pressure-control instrument (non-recording type) has been announced by Neilan Company, Ltd., 641 Santa Fe Ave., Los Angeles, Calif. This new instrument is made to control pressures in ranges from 0 to 5,000 lb. The controller has been greatly simplified in design and embodies a compound pilot valve and sliding wedge actuating block which enables any degree of sensitivity to be obtained at any point on the instrument's pressure range.

Pressure control instrument for pressures from 0 to 5,000 pounds

The case and many parts are made of duralumin with certain internal working parts of stainless steel.

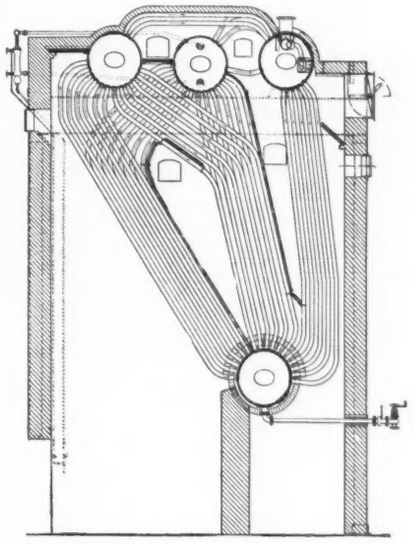
Improved Screw Hoist

LIGHT, compact and particularly suitable for general repair work where it must be continually carried about and operated in different places is the Model 30 hoist, put out by the Wright Manufacturing Company, Bridgeport, Conn.

Designed on the worm-wheel principle, it has few parts, and is of simple construction. It is equipped with special - analysis - steel load chains, heat-treated, drop-forged hooks, chain guards shrouding the complete upper half of the load wheel and preventing the load chain from riding out of the wheel pockets.

Multiple Circulation Boiler

DEPARTURE from conventional designs in two essentials—tube arrangement and steam liberation has been made in the multiple circulation boiler recently introduced by the Combustion Engineering Corporation, 200 Madison Ave., New York City. In the new boiler, which is designed to insure adequate circulation and correct steam liberation under the most severe operating conditions, the tubes in the first pass are arranged so that half of them enter the front drum and the other half enter the middle drum. The tubes in the second pass are arranged similarly. This tube arrangement effects a double circulation in the boiler. One circulation is up half the tubes in the front tube-bank to the front upper drum, then down the tubes running into the middle tube bank to the lower steam and water drum. The other circulation is up the other half of the tubes in the front tube bank, which run into the middle upper drum, then down half the tubes in the middle tube bank to the lower steam and water drum.



One-half of the tubes in first and second passes connect to the front drum and the other half to the middle drum

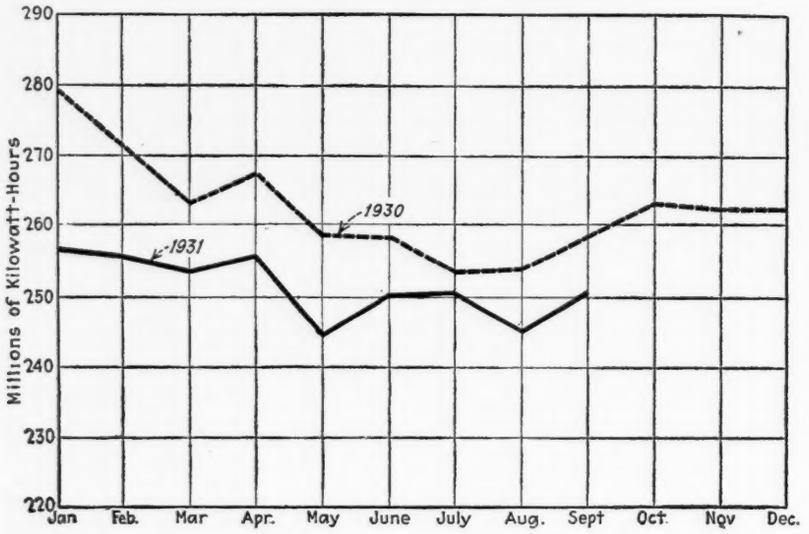
This splitting of the circulation tends to equalize the steam liberation in the upper front and middle drums and thus eliminates the usual intense turbulance where the greater part of the steam is liberated in the front drum.

To assure dry steam production, the steam circulators are increased in number over the conventional design. A further change in design consists in connecting the steam circulators from both the front drum and the middle drum directly into the rear drum. This arrangement tends to give drier steam and lower steam velocity.

This boiler is available in sizes ranging from about 2,000 sq.ft. to 26,000 sq.ft. of heating surface. It is adaptable to any type of firing and may be set double.

NEWS of the FIELD

Public Utility Power Production 4.5 Per Cent Below Last Year at End of Third Quarter



Average daily production of public utility power plants

ELECTRIC POWER production of public utility power plants in the United States during the first nine months of this year totaled 68,736,000,000 kw.-hr., as compared with 71,941,000,000 kw.-hr. produced in the corresponding period of 1930, according to figures just released by the Geological Survey of the Department of the Interior. This amounts to a decrease of 4.5 per cent from last year's production and a drop of 4 per cent under the production level of the same period, 1929.

As shown by the chart, average daily production of electricity by public-utility plants in Sept., 1931, was 251,900,000 kw.-hr., 25 per cent more than the daily production for August and about the same as the output for July.

The production of electricity by the use of water power continues to be less than last year and shows about the same seasonal change as last year. During the first nine months of 1931 hydroelectric power amounted to 35 per cent of the total output, as compared with 37 per cent for the corresponding period last year. There will be no improvement in production of electricity by the use of water power until the flow of power streams has been substantially increased by a marked increase in precipitation, the Geological Survey states.

Power production figures of the Geological Survey are based on the operation of all power plants producing 10,000 kw.-hr. or more per month, engaged in generating electricity for public use, including central stations, both commercial and municipal, electric railway plants, plants operated by steam railroads generating electricity for traction, Bureau of Reclamation plants, public works plants and that part of the output of manufacturing plants which is sold for public use.

Stimson Rejects New York's Demands on St. Lawrence

SECRETARY OF STATE, Henry L. Stimson, in a letter to Frank P. Walsh, chairman of the New York Power Authority, Nov. 3, refused to grant the New York request that the points at issue between the federal and state governments over the St. Lawrence deeper waterways project be adjusted before negotiations are begun with Canada for a treaty to govern the development of the waterway.

Mr. Stimson asserted that the federal government has predominant legal rights over the utilization of electric power resulting from the development. He declared his readiness, however, to consult with New York representatives at all times and to keep the state informed of the progress of the negotiations, and his intention to see that New York's interests are safeguarded.

The letter followed a discussion between Mr. Walsh and Colonel Stimson, when Mr. Walsh, in a memorandum, outlined New York's interest in the St. Lawrence project and contended for power privileges incident to riparian rights of the state along the international section of the waterway.

Boiler Sales Increasing; Stokers, Pulverizers Off

THOUGH NEARLY 50 per cent below last year, sales of boilers showed an increase during the third quarter of this year, according to the United States Bureau of the Census. The number sold in September was 893 of 692,238 sq.ft. as compared to 827 of 594,698 sq.ft. in August. On the other hand sales of mechanical stokers and pulverizers, which are only 30 per cent under last year and indicate that many boilers in service have been equipped for mechanical firing, showed a marked decrease during the third quarter. In September 96 stokers of 22,462 hp. were sold compared with 132 of 31,171 hp. in August, while sales of pulverizers decreased from 10 with a total capacity of 35,750 lb. in August to 8 with a capacity of 20,600 lb. in September.

For the first nine months of this year new orders were placed for 6,445 boilers of 5,943,882 sq.ft., compared with orders for 10,386 boilers of 11,321,993 sq.ft. in the corresponding period of 1930. The following table gives the number, kind and square footage of all boilers sold during the first three-quarters of 1930 and 1931:

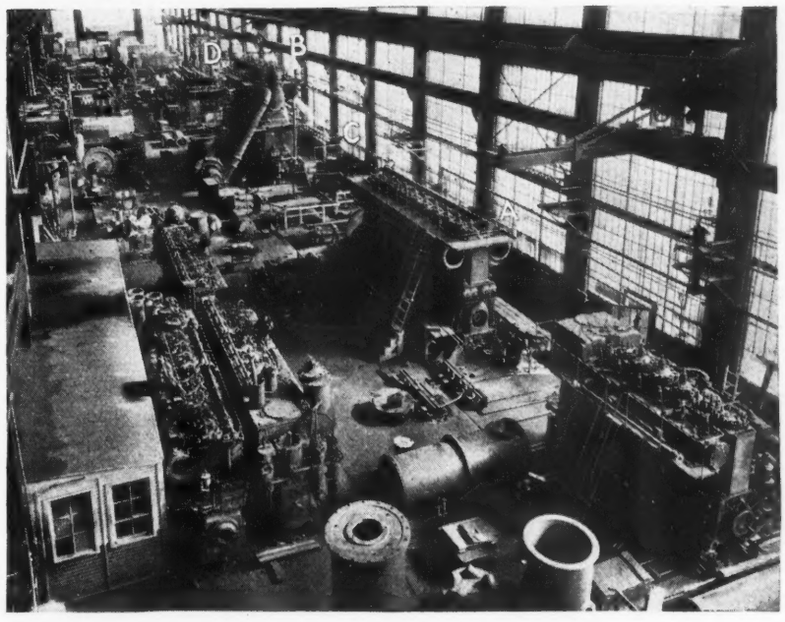
	1930		1931	
Kind	No.	Sq.Ft.	No.	Sq.Ft.
Stationary:				
Water tube....	906	4,815,193	556	2,353,051
Horizontal return tubular.	739	1,002,906	404	506,193
Vertical fire tube	897	275,840	475	129,579
Locomotive (not railway)	131	107,713	77	68,681
Steel heating...	6,181	2,775,864	4,167	1,823,249
Oil country....	856	976,736	338	[illegible] 68
Self contained portable.....	348	243,848	283	178,717
Miscellaneous....	117	103,318	50	27,480
	211	1,020,575	142	474,567
Total.....	10,175	10,301,418	6,303	5,469,315
Marine:				
Water tube....	149	979,926	80	437,141
Pipe.....	3	3,217	4	5,240
Scotch.....	52	33,504	48	22,516
Miscellaneous..	7	3,928	10	9,670
Total.....	10,386	11,321,993	6,445	5,943,882

Sales of mechanical stokers of over 300 lb. capacity in the first nine months of 1931 totaled 799 stokers of 204,370 hp., compared with 963 stokers of 294,559 hp. in the first half of last year. Of those sold this year, 406 were for installation under water-tube boilers of 1,444,430 sq.ft. and 393 were for fire-

tube boilers of 599,270 sq.ft. In addition to these the new classification compiled by the Census Bureau shows that during the first nine months of this year 677 stokers of 200 to 300 lb. capacity were sold, together with 959 of 100 to 200 lb. and 3,924 of less than 100 lb. capacity.

Orders for pulverizers for boiler installations in the first three-quarters of this year aggregated 103 pulverizers with a total capacity of 683,260 lb. of coal per hour contract. Of these 7 having a combined capacity of 220,000 lb. were for use in the storage system to fire water-tube boilers; 64 with a total capacity of 427,960 lb. were for use in the unit system to fire water-tube boilers; and 32 with a capacity of 35,300 lb. were for use in the unit system with fire-tube boilers. Comparable figures for the first six months of 1930 are not available.

15,000 HP. OF DIESELS ON TEST FLOOR



ALTHOUGH the manufacture of diesel engines has suffered along with all other industries during the depression, a large horsepower of engines is going through various manufacturing plants at the present time. The illustration shows 15,000 hp. on the test floor at the Busch-Sulzer Bros. Diesel Engine Company's factory in St. Louis, Mo. The engine marked *A* is a 10-cylinder, 3,300-hp., two-cycle, solid-injection unit for the City of Freeport, N. Y. *B* is a 6-cylinder, solid-injection engine for the Tucson Gas & Electric Company, Tucson, Ariz., while *D* is similar to *A* for the Sterling plant of the Public Service Company of Colorado, and *C* is a small 450-hp., four-cycle unit. The other engines shown are two-cycle, air-injection units for pipe-line service.

Form Unemployment Relief Committee for Engineers

MEMBERS of the four national engineering societies, the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers and American Institute of Electrical Engineers, have organized a committee to help those of their members and other professional engineers who are in need because of unemployment.

The function of the committee is to find employment for professional engineers and to give financial aid to those in actual need of relief. The committee is headed by H. de B. Parsons as chairman, and functions through an executive committee, of which John P. H. Perry is chairman, a finance committee, and a relief committee. Mr. Parsons, a civil engineer of 26 Beaver St., New York, is a professor emeritus of Rensselaer Polytechnic Institute. Mr. Perry, a civil engineer, is vice-president of the Turner Construction Company, Chicago.

Headquarters are in the Engineering Societies' Building at 29 West 39th St. Many members of these societies are giving their time to this work. The committee will shortly announce its program.

Funds will be solicited for immediate relief and members will also be asked to help locate work. The committee is asking all professional engineers to look forward to helping to the utmost of their ability, and also to inform it promptly of any particular situations which demand immediate attention.

A few hundred engineers are wanted now for a piece of work that is expected to carry through the winter.

One of the functions of the committee will be to work against the general lowering of salaries paid to engineers by finding employment in fields outside the profession. A great number of unemployed engineers, due to the stringency of their financial situation, are offering to work at rates entirely disproportionate to the value of their services, it is stated, and the result is that the going price of the commodity known as "Engineering Service" is rapidly diminishing. If wholesale salary cutting takes place during each depression, all cumulative effort to raise the standard of remuneration for the engineering profession will be lost. The committee intends to fight this scale-down by encouraging and helping engineers to enter other fields.

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Second Lincoln Arc Welding Contest Has Many Entries

THE Second Lincoln Arc Welding Price Competition which will award $17,500 for the best papers on redesign for arc-welded construction closed Oct. 1, with four times as many papers entered as in the former contest sponsored by the Lincoln Electric Company, of Cleveland, Ohio.

Oct. 1, with four times as many papers by a jury of award headed by Dr. E. E. Dreese, chairman of the electrical engineering department of Ohio State University, was begun Nov. 1.

Interest in this contest has been international in scope with sixteen foreign countries represented, Germany, France, England and Australia submitting a remarkable number of papers.

Smoke Violations Reduced 85 Per Cent in New York

VIOLATIONS of the smoke ordinance in New York City have been reduced more than 85 per cent during the past year through the efforts of the Health Department, according to Dr. Thomas Darlington, head of the trial board for offenders. While the board heard an average of 70 to 80 cases weekly when the smoke abatement work started a year ago, only 8 to 10 cases are now brought each week, he stated.

Most offenders, Dr. Darlington said, have not known that they were making smoke and have taken corrective steps after being apprised of their offense.

On the other hand, Dr. Darlington explained, it has been found difficult to prove to the courts that smoke from chimneys constituted a health menace. He said he had been informed that in one or two of the cases lost in court the lawyers' fees for the defense have been far more than the cost of correcting the smoke nuisance.

Dr. Darlington held that lack of education as to the harmfulness of smoke was mainly responsible for the nuisance. A survey of the city from tall buildings, he said, would show that at present the air is free, except for the smoke coming from power houses and heating plants, since the private owner has brought about more improvements.

L. T. Robinson, Head of G. E. Laboratory, Dies

LEWIS TAYLOR ROBINSON, engineer in charge of the general engineering laboratory of the General Electric Company, died suddenly Nov. 3 of a heart attack at his home in Schenectady, N. Y. He was 63 years old and one of the best known electrical engineers in America.

Born in Springfield, Mass., on Oct. 20, 1868, Dr. Robinson was educated at Lynn and Reading, Mass. At the age of seventeen he went to work for the old Thomson-Houston company in Lynn and was soon thereafter put in charge of the company's standardization laboratory, where his chief endeavor was the improvement of electrical instruments.

Later Dr. Robinson was a junior partner in Whitmore & Robinson, and conducted a laboratory for testing and calibrating electrical devices. In 1896 he took charge of the standardizing laboratory of the General Electric Company in Schenectady. When this laboratory was consolidated in 1919 with the consulting engineering laboratory founded by the late Dr. Charles P. Steinmetz, Dr. Robinson was appointed engineer-in-charge. Under his direction the laboratory brought out many new devices including the mercury-arc rectifier, oscillograph and photophone. Dr. Robinson held 30 patents.

The recipient of many honors, Dr. Robinson was a member of the American Institute of Electrical Engineers, National Electric Light Association, American Physical Society, International Electrotechnical Commission and American Asociation for the Advancement of Science.

Condenser Intake Found Defective at Tacoma Plant

WITH ACTUAL PROOF, through the unwatering of the condenser intake of the city of Tacoma's (Wash.) new steam power plant, that the concrete of the intake floor slab is defective, and is the source of the sand and gravel that got into the condenser on its first test several months ago, one engineer of the city light department has been discharged and an instrument man has been suspended, following a complete investigation by Commissioner Ira S. Davisson of the public utilities department.

Cold water enters the concrete intake chamber from the Hylebos waterway for the condenser. This concrete slab, it was found, had not properly set under water and was too high, with only a foot of clearance between it and the condenser intake pipes, instead of the specified 30 inches.

V. R. Rathbun, resident engineer in full charge of the steam plant construction, is the engineer discharged for failure to perform his full duties. He has admitted that he did not see the bottom of the intake himself but relied upon his inspectors, according to Commissioner Davisson.

Kenneth Danstrom, instrument man, who was responsible for levels in the intake, was suspended pending the final hearings on the matter. Commissioner Davisson states he has been unable to find extenuating circumstances for the failure to discover the defective character and level of the intake floor.

A board of engineers, appointed by Commissioner Davisson, is now working on plans to repair the intake.

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COMING CONVENTIONS

American Society of Mechanical Engineers. Annual meeting in New York City, Nov. 30-Dec. 4. Secretary, Calvin W. Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. Annual winter convention in New York City, Jan. 25-29, 1932. Secretary, F. L. Hutchinson, 33 West 39th St., New York.

American Society of Refrigerating Engineers. Joint meeting with the A.S.H.V.E. and annual convention at the Hotel Cleveland, Cleveland, Ohio, Jan. 26-29, 1932. Secretary, David L. Fiske, 37 West 39th St., New York City.

American Water Works Association. Annual convention at the Hotel Peabody, Memphis, Tenn., May 2-6, 1932. Secretary, Beekman C. Little, 29 West 39th St., New York City.

International Acetylene Association. Annual convention at the Congress Hotel, Chicago, Ill., Nov. 11-13. Secretary, A. C. Morrison, 30 East 42d St., New York City.

National Association Practical Refrigerating Engineers. Annual convention and exhibition at the Municipal Auditorium, Houston, Tex., Nov. 10-13. Secretary, Edward H. Fox, 435 North Waller Ave., Chicago, Ill.

Seventh Annual Conference on Welding, to be held by the Engineering Extension Department of Purdue University at Lafayette, Ind., Dec. 10-11. Professor in charge, W. A. Knapp, Engineering Extension Department, Purdue University, Lafayette, Ind.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

SECTION MEETINGS

A.S.M.E., Metropolitan Section. Dinner meeting at the Building Trades Employers Association, 2 Park Ave., New York City, on Nov. 16 at 6:30 p.m. Subject: "Influence of Steam on Corrosion in Return Lines," R. E. Hall, Hall Laboratories, Inc., and A. R. Mumford, New York Steam Corporation.

A.S.M.E., West Virginia Section. Meeting in theater at Glen Ferris Inn, Glen Ferris, W. Va., on Nov. 14 at 2 p.m. Subjects: "The Engineer as a Citizen," President Roy V. Wright; "Hawks Nest-Gauley Junction Hydro-Electric Development," O. M. Jones, New Kanawha Power Company.

A.S.M.E., Worcester Section. Joint meeting with Worcester Chapter, A.S.S.T., at Worcester Polytechnic Institute on Nov. 19 at 6:30 p.m. Subject: "Corrosion and Heat Resisting Steels," T. H. Nelson, Midvale Steel Company.

Los Angeles Waterway Dynamited; Hydro Safe

TWO SECTIONS of the Grapevine Canyon siphon of the Owens River aqueduct of the Los Angeles, Calif., Department of Water and Power water supply system were destroyed by dynamiting early Nov. 2. Belief was expressed that the dynamiting was an act of vandals rather than a renewal of the former bitter controversy that prevailed between the city and ranchers of the Owens and Antelope valleys over the city's purchase of water rights. The aqueduct was dynamited nine times from 1924 to 1927, during the city's negotiations for water rights.

The two sections of the siphon blown out totaled 15 ft. in length. The Grapevine Canyon siphon is between Indian Wells and Little Lake, 50 miles from the town of Mojave. Flow through the aqueduct was shut off at Haiwee reservoir, 40 miles above the break.

H. A. Van Norman, chief engineer of the Department of Water and Power said that repairs to the damaged section would require about four days. Water in storage in reservoirs near the city is ample to supply the demand while repairs are being made, he said. Water for the operation of the city's hydro-electric plants in San Francisquito canyon is from the Fairmount reservoir, below the damaged sections of the aqueduct.

Electrical Telegraph Code Takes Effect on Nov. 16

WITH THE GOING into use on that date of "LCode," the complete industry code book just issued by the Business Code Company, New York City, Nov. 16 will mark a new era in telegraphic communication in the electrical industry.

"LCode" contains five-letter code words covering expressions in every branch of the electrical field, including all words and phrases used in the purchase and sale of equipment and supplies, and is of such convenient size and arrangement that any message can be easily and quickly coded. There is also included an ingenious arangement of flexible phrase tables enabling one to reduce to one code work combinations of short works invariably used in all messages. This feature avoids ambiguity which so often occurs when words are eliminated to shorten messages.

Sponsored by the N.E.M.A., N.E.L.A. and five other societies representative of the entire industry, the code is expected to effect a saving of from 40 to 70 per cent in the cost of telegraphic communications. None of the sponsoring or cooperating organizations is profiting in the sale of "LCode." The list price of $6.50 carries customary quantity discounts and an additional discount based on membership in any one of the sponsoring groups.

Personals

PROF. KALMAN J. DE JUHASZ, of the Experiment Station at Pennsylvania State College, is the recipient of the Rudolph Diesel Award for 1931 for his paper entitled "Dispersion of Sprays in Solid Injection Oil Engines," which was selected by the board of award as the best paper presented at the National Meeting of the Oil and Gas Power Division of the American Society of Mechanical Engineers, held last June at the University of Wisconsin. Presentation of the award, together with the accompanying prize of $100 donated by the Diesel Engine Manufacturers Association, will be made on Dec. 3 at the oil and gas power session of the annual meeting of the American Society of Mechanical Engineers, in New York City, Nov. 30 to Dec. 4.

W. R. HILL, erector for the Babcock & Wilcox Company in the New York district, retired recently after 44 years of service with the company. J. G. BRANDT has been appointed district erector of New York to succeed Mr. Hill.

CARL A. PETERSON, formerly designing engineer for the Atwood-Bradshaw Corporation, Pittsburgh, has been made chief engineer and a director of the company. RALPH N. ROBERTSON, who recently resigned as chief mechanical engineer of the Blaw-Knox Company, Pittsburgh, to join the Atwood-Bradshaw Corporation, as announced in *Power* for Oct. 20, has just been appointed vice-president and a director of the Atwood-Bradshaw concern.

PROF. PAUL B. EATON has been appointed head of the department of mechanical engineering at Lafayette College, Easton, Pa. ERNEST M. FERNALD, assistant professor of mechanical engineering at Lafayette, has been advanced to the rank of associate professor.

ALFRED E. WALLER, formerly chief engineer of the Ward Leonard Company, and managing director of the National Electrical Manufacturers Association has joined the Clark Controller Company's organization, and will make his headquarters at the Sundh Electric Company's plant in Newark, N. J.

WILEY F. CORL, vice-president of the United Gas Improvement Company, Philadelphia, has resigned to become vice-president of the International Utilities Corporation, New York City, in charge of all its subsidiaries. Mr. Corl has had extensive engineering and executive experience in the power utility field.

CLARENCE H. KENT, formerly head of the mechanical engineering department at the University of Arkansas, has been appointed associate professor of mechanical engineering at Pennsylvania State College.

How's Business?

PROSPECTS of a general and vigorous upturn in business early next year have been strengthened almost to certainty by underlying developments during the past month. Year-end, new-model automotive activity and belated railroad buying have given some unseasonal stimulus to steel production. October residential building, and current carloadings show encouraging strength. There are evidences of sporadic employment in coal, shoes, silk, canning, and of course a strong upswing of "sentiment" under the stimulus of strength in security and commodity markets. The end of October, with business 32 per cent below normal, may prove to be the low point of the depression, but expectations of immediate or material pick-up before the end of the year may be discounted and the possibility of set-backs in speculative sentiment under discouraging news from abroad during the next two months must be kept in mind.—*The Business Week*, Nov. 11.

Business Notes

GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces that its employees have voted by a large majority to accept the new unemployment relief plan recently offered to them by the company. The plan provides for rotation of available work and other means by which hourly-rated and piecework employees on the payroll Nov. 1 may be assured of receiving, during the following six months, not less than the equivalent of one-half of their average full-time weekly earnings up to an average of $15 per week, and their actual earnings in case the latter amount to more than $15 per week. The unemployment emergency fund of the company, to which those employees earning 50 per cent or more of their average full-time earnings now contribute one per cent of their earnings will be augmented Nov. 1 by increasing this contribution to two per cent, the company contributing an equal amount.

FOOTE BROS. GEAR & MACHINE COMPANY, Chicago, Ill., definitely announces the abandonment of its proposed merger with the Dodge Manufacturing Company, of Mishawaka, Ind. In a letter to stockholders President J. F. Griswold, of Foote Bros., says in part: "The reduction of the volume of business for the year 1931 and the consequences attendant thereon, and the economies which were forced and were successfully put into operation, combined with a brighter sales outlook for your company in its own particular line of business, which I now believe exists, finally convinced the Depository Committee and your officers that the best interests of the corporation would be served by the abandonment of the merger. . . ."

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., announces the appointment of Ralph Leavenworth as general advertising manager, in charge of all advertising and publicity activities of the company. Since Jan. 1, 1930, Mr. Leavenworth has been general sales manager of the Austin Company, one of the world's largest engineering and building organizations.

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Trade Catalogs

BOILERS — Combustion Engineering Corporation, 200 Madison Ave., New York City, has just issued a pamphlet (MC-1) describing the C-E multiple circulation boiler, which is available in sizes ranging from 2,000 to 26,000 sq.ft. of heating surface. This boiler is adaptable to any type of firing and may be set double.

BLOWERS, ALTERNATORS, CONTROLLERS —Three new illustrated bulletins have just been issued by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Bulletin No. 1907 on turbine-blowers and turbine-compressors covers the new line of equipment recently purchased by Allis-Chalmers from the American Brown-Boveri Company, and shows the application of this equipment in a variety of fields. Bulletin No. 1153 describes engine-type alternators and their uses in connection with large diesel and gas engines. Bulletin No. 1151-A on the Rossman system of adjustable-speed control shows recent applications of this system to the operation of auxiliary equipment in large plants.

PACKINGS—Metallic and fabric packings are described and illustrated in two new catalogs of the Crane Packing Company, 1800 Cuyler Ave., Chicago, Ill. Catalog No. 20 covers the company's general line of fabric packings, mechanical rubber goods and engineering specialties, while Catalog No. 30 contains information and specifications on various types of metallic packing for engines, pumps, valves, etc.

THRUST BEARINGS—The dimensions, capacities and typical mountings of self-aligning equalizing types of horizontal and vertical thrust bearings are fully described in Bulletin HV just issued by the Kingsbury Machine Works, Inc., Frankford, Philadelphia, Pa. The bulletin contains many illustrations and tables of data, and covers the general applications of these bearings.

NEW PLANT CONSTRUCTION

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Fresno—J. L. Laino, plans the construction of a 40 x 219 ft. ice manufacturing plant on 9th St. Estimated cost excluding equipment $27,000.

Calif., Sacramento — Sacramento Municipal Utility District, plans an election December 16 (tentative date) to vote $12,600,000 bonds for Mountain water supply system including reservoir, and two rock fill dams, one 235 ft. high and 220 ft. long. To be known as Silver Creek Project. A. Givan, 2175 35th St., is engineer.

Calif., San Diego—Charles Gabriel, 661 East St., San Bernardino, awarded contract for the construction of a 1 story, 50 x 107 ft. ice manufacturing plant at El Cajon and 38th Sts., to Olmstead Building Co., 2255 5th Ave., San Diego. Estimated cost $40,000. Equipment contract awarded.

Conn., Hartford—Hartford Electric Light Co., 266 Pearl St., awarded contract for the construction of two steel tanks, 50,000 bbl. capacity each to Chicago Bridge & Iron Works, 250 Stuart St., Boston, Mass., and pipe line and steel building, 15 x 20 ft. to Blaw Knox Co., Pittsburgh, Pa.

Ill., Wilmette—Town plans election December 5 to vote $4,000,000 bonds for new Lake Michigan water supply system including intake pumping station, 6 m.g.p.d. filter plant, etc. Pearse, Greely & Hansen, Tower Bldg., Chicago, are engineers.

Ind., Vincennes—Orville Stout, will build a corn mill and grain elevator at 506 Broadway. Estimated cost $50,000. Bacon & Tislow, 1015 Architects Bldg., Indianapolis, are architects. Work will be done by separate contracts.

Ia., Anamosa—State Board of Control, Des Moines, awarded contract for improvements to waterworks and distribution system including collecting well, pump house, pumping equipment, etc., at Men's Reformatory here, to E. L. Royer Construction Co., Valley Junction, Ia. $22,933.

Mass., Boston — Commonwealth of Massachusetts, Dept. of Public Works, will receive bids until December 1 for an 8 story office building on Nashua St. Estimated cost $1,500,000. E. T. P. Graham, 171 Newbury St., is architect.

Mass., Springfield—Gibralta Garage & Office Co., W. A. Dunne, Highland Hotel, completed plans for an 8 story, 200 x 205 ft. office and garage building at Vernon St. and Columbus Ave. Estimated cost $1,000,000. L. S. Joslin, 339 Newbury St., Boston, is architect.

Mass., Watertown—E. J. Sancomb, 33 Thaxter Road, Newtonville, is having plans prepared for a 1 story laundry including addition to boiler plant on Acton St. here. Estimated cost $40,000. William Haines & Son, 32 Riverview Ave., Waltham, are architects.

Minn., Minneapolis—Treasury Department, Office of J. A. Wetmore, Supervising Architect, Washington, D. C., will soon award contract for the construction of first unit of post office building 4 story, 165 x 540 ft. at Nicollet St., Third Ave. S., First and High Sts. Estimated total cost $3,500,000. Magney & Tusler, 104 South 9th St., Minneapolis, are architects.

Minn., St. Paul—T. P. Chapman, 605 Minnesota Bldg., is having plans prepared for a 10 story hotel including steam heating system, etc., at 460 Summit Ave. Estimated cost $1,000,000. Ellerbe & Co., 525 Minnesota Bldg., are architects.

Mont., Great Falls—City awarded contract for 53 x 56 ft. addition to waterworks pumping station to Ferche & Karaffa, Great Falls. $23,601.

N. J., Jersey City—Board of Commissioners, J. Wasser, Clk., City Hall, is having revised plans prepared for the construction of a 15 story psychopathic hospital including steam heating and ventilation systems, etc., at Baldwin and Montgomery Sts. Estimated cost $750,000. John T. Rowland, Jr., 30 Journal Sq., is architect.

O., Piqua—City voted $810,000 bonds for the construction of electric light and power plant. Burns & McDonnell Engineering Co., 406 Interstate Bldg., Kansas City, Mo., is engineer.

O., Rocky River—City will receive bids until November 14 for a sewage disposal plant including pump house and administration building. Estimated cost $90,000. C. W. Courtney, East 11th St. and Walnut Ave., Cleveland, is engineer.

Pa., Munhall—Borough of Munhall, L. Y. Woodward, Secy., Main Bldg., awarded contract for waterworks improvements including pumping station, etc., to Nicola Building Co., 6388 Penn Ave. Equipment including pumps, motors and electric equipment awarded to Chicago Pump Co., Oliver Bldg., Pittsburgh.

Tenn., Memphis—Board of Water Commissioners, awarded contract for seven 80 ft. cook patent all brass well strainers to be used in wells of James Sheahan water pumping station at Normal State Teachers College to Carloss Well Supply Co., Front and Gayoso Sts. Estimated total cost $2,000,000.

Tenn., Nashville — Warner Bros. Theatres, Inc., of Tennessee, H. R. Maier, 321 West 44th St., New York, N. Y., awarded contract for the construction of a 12 story theatre and office building at 6th and Church Sts., here to G. A. Zimmerman Corp., 19 East 41st St., New York, and Sumner Construction Co., Sumner Bldg., Nashville. $600,000. Total cost $1,250,000.

Texas — West Texas Utilities Co., Abilene, plans improvements to electric power plants at San Angelo, Mason and Quanah to include transformer racks, meter equipment and primary lines, etc., also extensions and improvements to electric power plants and waterworks systems in towns of Stratford, Winters, Rising Star and Dalhart. Private plans.

Tex., Amarillo—H. C. Badger and A. Davidson, awarded contract for the construction of a 1 story, 70 x 145 ft. ice plant, 75 ton capacity to Albert Randall, Amarillo. Estimated cost $60,000.

Ont., Abitibi Canyon—Abitibi Power & Paper Co., 88 University Ave., Toronto, awarded contract for three 13,000 and six 9,500 kva. transformers, in connection with hydro-electric power development on Abitibi River here to Canadian Westinghouse Co., Ltd., Metropolitan Bldg., Toronto.

Ont., Renfrew—Town plans rebuilding Golden Lake dam also construction of Clear Lake dam for water regulation in connection with hydro-electric plant. Estimated cost $30,000. J. R. Stewart is engineer.

Equipment Wanted

Pump—Fairfield, Calif.—City, L. Morrill, Clk., is receiving bids for furnishing and installing pump in connection with water system.

Transformers—San Francisco, Calif.—Board of Public Works, S. J. Hester, Secy., will receive bids until Nov. 18 for three electric power transformers in connection with enlargement of Seco sub-station for pumping water through Corral Hallow pipe line (Hetch Hetchy project).

Pumps—Fort Lyon, Colo.—Construction Service, Veterans Administration, Washington, D. C., will receive bids until November 24 for three deep well pumps at Veterans' Hospital here.

Pumps—Boise, Idaho—Supervising Supt. of Construction, U. S. Veterans Hospital, Palo Alto, Calif., will receive bids until Nov. 24 for furnishing and installing two horizontal direct connected motor driven booster pumps, etc., in connection with waterworks at U. S. Veterans Hospital here.

Pump—Vinton, Ia.—City rejected bids received Oct. 21 for pump, etc., in connection with waterworks, $13,000.

Pump, etc.—Fort Bliss, Tex.—Quartermaster Corps, will receive bids until Nov. 18 for furnishing and installing a deep well turbine pump, etc., in connection with waterworks.

Pump—Niagara Falls, Ont.—Water Commission, J. L. Stanley, Mgr., wants prices supply and delivery of a 4,000,000 gal. water pump for waterworks.

Pumps, etc.—Oshawa, Ont.—City will soon receive bids for pumps, etc., for proposed waterworks filtration plant.

Pump—Pembroke, Ont.—Town Council, will soon receive bids for supply and installation of a 12,000 g.p.m. pump, etc., in connection with waterworks filtration plant. Estimated cost $100,000.

Industrial Projects

Calif., Berkeley—B. F. Sturtevant Co., 2530 Sixth St., plans the construction of first unit of plant for the manufacture of ventilating apparatus, etc., at Gilman, Camelia, 9th and 8th Sts. Estimated cost $500,000.

Calif., Oakland—Clorox Chemical Co., 850 42nd Ave., will build a chemical plant. Estimated cost $40,000. Work will be done by owners' forces. Steel contract awarded to California Steel Co., Second and Harrison Sts.

Ind., Elkhart—Illinois Carton Co., 2601 North Crawford Ave., Chicago, Ill., completed plans for a 1 story, 130 x 200 ft. factory at Clark and Elkhart Sts. here. Estimated cost $40,000. Private plans.

Ind., Hammond—Lever Bros. Co., 164 Broadway, Boston, Mass., manufacturer of soap, is having plans prepared for a 4 story addition to factory here. Estimated cost $1,000,000. Stone & Webster, Inc., 49 Federal St., Boston, Mass., are architects.

Mass., Webster—Webster Mills, L. C. Coats, Webster, c/o American Woolen Co., Shawsheen, awarded contract for the construction of a 2 story, 54 x 55 ft. addition to power plant on East Main St. here to Chester S. Patten, 638 Main St., Melrose. Estimated cost $40,000. Boilers and equipment not yet purchased.

Mich., Detroit—Timken Detroit Axle Co., Clark Ave., plans alterations to plant for the manufacture of Timken silent automatic oil burners. Estimated cost to exceed $40,000. Work will probably be done by day labor.

Mo., St. Louis—Kranz Automotive Body Co., 3032 Gravois Ave., awarded contract for a 1 story, 54 x 125 ft. automobile body plant at 3127-29 Minnesota St., to Henry Dilschneider Real Estate & Building Co., 7914 Kingsbury St.

N. J., Elizabeth—Parkinson & Co., 306 Montclair Ave., Newark, Archts., are receiving bids for a 1 and 2 story, 60 x 190 ft. tallow factory for I. Schonwalter, Meadow Lane, Elizabeth. Estimated cost $40,000.

N. Y., New York—Superior Fireproof Door & Sash Co., 1811 Carter Ave., is having sketches made for a 2 story, 50 x 100 ft. factory at Barnard and Barbour Sts. Estimated cost $40,000. H. Ginsberg, 205 East 42nd St., is architect.

N. Y., Winfield — Vincent Scudderi, 4009 82nd St., Jackson Heights, will build a 2 story, 94 x 100 ft. factory and warehouse here. C. Stodolph, Elmhurst, is architect. Work will be done by day labor and separate contracts. Sutro Products Co., 4009 82nd St., Jackson Heights, manufacturers of metal ceilings, is lessee.

N. Y., Woodhaven—Lalance & Grosjean Mfg. Co., 405 Lexington Ave., New York, plans the construction of a 40 x 75 ft. boiler room including equipment at 92nd St. and 95th Ave.

R. I., East Greenwich—Greenwich Mills, are receiving bids for a 2 story mill building. Estimated cost $40,000. C. T. Main Inc., 201 Devonshire St., Boston, are engineers.

Tex., Marshall—Marshall Cotton Oil Co., c/o W. C. Pierce, awarded contract for a 2 story, 50 x 160 ft. cotton seed products plant and warehouse, 70 ton capacity, to Frank Moos & Son, Marshall. $38,000. Contract for machinery awarded.

Ont., Hamilton—Canadian Westinghouse Electric Co., N. S. Braden, Mgr., preparing plans for addition to plant. Estimated cost $250,000. Equipment will be installed.

Ont., Walkerville—Walkerville Dairy Co., W. R. Knowles, Mgr., is having plans prepared for the construction of an ice cream plant. Estimated cost $150,000. Interested in prices on complete equipment.